In the name of God

In memory of

Dr. Alireza Gorji

1345-1403

15th Biennial Electrochemistry Seminar of Iran

Contents

Editorial Note:

Dear Colleagues and Students,

We are pleased to announce the organization of the "15th Biennial Electrochemistry Seminar of Iran (15BESI2024)," which will take place on October 30 and 31, 2024, at Yazd University, Department of Chemistry, in Yazd, Iran. The 15BESI2024 seminar aims to provide a platform for the dissemination of knowledge and recent research findings across all fields of electrochemistry, engaging both the academic community and industry professionals. The primary objective of 15BESI2024 is to foster scientific collaboration among academics, researchers, students, and experts from the chemical industry, thereby establishing a robust connection between these communities. The seminar program will include special sessions featuring invited speakers, poster and oral presentations, an exhibition of chemical equipment, and workshops related to the chemical industry.

I would like to express my gratitude to the board of directors of the Iranian Chemical Society for granting us the opportunity to host 15BESI2024, as well as to the members of the scientific committee for their peer review of abstracts, and to the executive committee members for their support.

We hope that your experience in Yazd will be enjoyable and that 15BESI2024 will create an environment conducive to the pursuit of new scientific knowledge and horizons.

Dr. Hamid Reza Zare

Professor of Analytical Chemistry

Chair, 15BESI

Scientific Committee

Prof. Karim Asadpour, Tabriz University

Prof. Masoud Ayatollahi, Isfahan University

Prof. Ali Benvidi, Yazd University

Asst. Prof. Ghasem Barati Darband, Ferdowsi University

Prof. Ali Asghar Ensafi, Isfahan University of Technology

Assoc. Prof. Hossein Farsi, Birjand University

Prof. Khalil Farhadi, Urmia University

Assoc. Prof. Ali Ghaffarinejad, Iran University of Science and Technology

Prof. Mohammad Bagher Gholivand, Razi University

Prof. Mirghasem Hosseini, Tabriz University

Prof. Fahimeh Jalali, Razi University

Assoc. Prof. Mohammad Ali Kamiabi, Zanjan University

Assoc. Prof. Habibollah Kazemi, Institute for Advanced Studies in Basic Sciences University

Prof. Mohammad Mazloum-Ardakani, Yazd University

Prof. Mohammad Hossein Mashhadizadeh, Kharazmi University

Assoc. Prof. Mehdi Mousavi, Shahid Bahonar University

Prof. Mir Fazlollah Mousavi Kouzekanan, Tarbiat Modares University

Prof. Parviz Norouzi, Tehran University

Prof. Mansour Namazian, Yazd University

Prof. Davood Nematollahi, Bu-Ali Sina University

Prof. Reza Ojani, Mazandaran University

Assoc. Prof. Ahmad Rohollahi, K. N. Toosi University of Technology

Asst. Prof. Mahmoud Roshani, Ilam University

Prof. Jahanbakhsh Raouf, Mazandaran University

Prof. Behzad Rezaei, Isfahan University of Technology

Prof. Alireza Rezvani, Sistan and Baluchestan University

Prof. Seyed Saeed Seyed Hosseini Davarani, Shahid Beheshti University

Prof. Abdollah Salimi, Kurdistan University

Prof. Majid Soleimani, Imam Khomeini International University

Prof. Esmaeil Shams, Isfahan University

Asst. Prof. Hasan Shayani Jam, Zanjan University

Assoc. Prof. Javad Tashkhourian, Shiraz University

Assoc. Prof. Esmaeil Tamari, Persian Gulf University

Asst. Prof. Fahimeh Varmaghani, Institute for Advanced Studies in Basic Sciences University

Prof. Abdollah Yari, Lorestan University

Prof. Hamid Reza Zare, Yazd University

Executive committee:

Prof. Mohammad Mazloum-Ardakani, Scientific committee chair, Yazd University

Prof. Hamid Reza Zare, Organization committee chair, Yazd University

Mr. Mohammad Hasan Kahdouei, Executive Deputy of the Seminar, Yazd University

Prof. Mohammad Abdollahi, Yazd University

Prof. Ali Benvidi, Yazd University

Assist. Prof. Meisam Safari, Yazd University

Asst. Prof. Hadi Basharnavaz, Yazd University

Prof. Shayesteh Dadfarnia, Yazd University

Assoc. Prof. Ahmad Ali Dehghani-Firouzabadi, Yazd University

Prof. Ali Mohammad Haji Shabani, Yazd University

Asst. Prof. Robabeh Hajian, Yazd University

Prof. Abbas Ali Jafari, Yazd University

Assoc. Prof. Mohammad Kamalvand, Yazd University

Prof. Bibi Fatemeh Mirjalili, Yazd University

Assoc. Prof. Hossein Mohammadi Manesh, Yazd University

Prof. Mansour Namazian, Yazd University

Prof. Fatemeh Tamaddon, Yazd University

Prof. Rasoul Vafazadeh, Yazd University

Student executive committee

Ph.D. Students:

Mrs. Sara Dehghan-Chenar

Mr. Hamid Dehghan-Manshadi

Mrs. Hafezeh Morsalpour

Mr. Hamed Arabi

Mrs. Mansoureh Alighiyan

Mrs. Zakieh Salehi

Master and Bachelor Students:

Mrs. Mahshid Abdollahi
Mrs. Fatemeh Ahmadzadeh
Mrs. Ghazaleh Alaei
Mr. Yasin Alinezhad
Mrs. Sara Choghadi
Mr. Hossein Dehshiri
Mrs. Zahra Esmaeili
Mrs. Farnaz Firoozi
Mr. Meysam Gharehdaghi
Mrs. Saba Heidari
Mrs. Shiva Houshmand
Mr. Hossein Karimi
Mr. Rasoul Keyghobadi

Mrs. Zahra Khademi
Mrs. Fatemeh Maleksabet
Mr. Amir Reza Mansouri
Mrs. Narges Mehrpour
Mrs. Niloufar Moghadamnia
Mrs. Masoumeh Mohammadi
Mr. Hasan Mohammadi
Mrs. Fereshteh Mohseni
Mrs. Zahra Rahimi
Mrs. Marzieh Rezvani
Mr. Mehdi Roostapour
Mr. Mohammad Reza Saeinia
Mrs. Fatemeh Shirvani
Mr. Mohammad Ali Shiyoukhi
Mr. Pouria Shokri
Mrs. Zahra Soori
Mr. Mohammad Mehdi Tabaei
Mr. Abbas Talebi
Mr. Ali Yavari

Key Speakers

دکتر مسعود آیت اللهی
دانشکده شیمی – دانشگاه اصفهان

Molecular drama on the interface: Where impossible becomes possible

Masoud A. Mehrgardi

Department of Chemistry, University of Isfahan, Isfahan, Iran
**E-mail:* m.mehrgardi@chem.ui.ac.ir

Abstract

In this seminar, we delve into the fascinating world of microdroplet chemistry, exploring the principles that govern reactions at interfaces. We discuss our recent publications in collaboration with prof. Richard Zare's group, Stanford University (1-5), which highlight groundbreaking advancements in this field. These include studies on the hydrogenation of carbon dioxide on the interface of microdroplets, the selective oxidation of alcohols to organic peroxides, and the formation of hydrogen peroxide (H_2O_2) and its sustained regeneration at the interface of water–gas microbubbles. These microbubbles, which act as extraordinary microreactors, facilitate thermodynamically unfavorable reactions in bulk solutions of water. By pushing the boundaries of traditional chemistry, we uncover new possibilities for innovation and discovery at the molecular level.

Keywords: Microdroplets, Microbubbles, Hydrogen Peroxide, Carbon Capture

References

[1] S. F. Nami-Ana, M. A. Mehrgardi, M. Mofidfar, R. N. Zare, *Journal of the American Chemical Society*, In-press.
[2] M. A. Mehrgardi, M. Mofidfar, J. Li, C. F. Chamberlayne, S. R. Lynch, R. N. Zare, *Advanced Science*, 11 (2024) 2406785.
[3] M. Mofidfar, M.A. Mehrgardi, Y. Xia, R. N. Zare, *Proceedings of the National Academy of Sciences*, 121 (2024) e2315940121.
[4] M. Mofidfar, M.A. Mehrgardi, R. N. Zare, , *Journal of the American Chemical Society,* 146 (2024) 18498.
[5] M. A. Mehrgardi, M. Mofidfar, R. N. Zare, *Journal of the American Chemical Society*, 144 (2022) 7606.

دکتر مجتبی باقرزاده

Electrochemical Corrosion Under Radioactive Irradiations

Mojtaba Bagherzadeh

Reactor and Nuclear Safety Research School, Nuclear Science and Technology Research Institute,
81465-1589, Tehran, Iran.
[*]*E-mail* mjmo123@yahoo.com

Abstract: The impact of radioactive radiation, gamma rays, and neutrons on corrosion in aqueous environments is a topic of significant importance [1]. In the such aqueous environments, radiolysis reactions and the release of electrochemically active species H_2, $HO^{\bullet}$, $H^{\bullet}$, $HO_2^{\bullet}$, H_3O^+, OH^-, H_2O_2 and, e_{aq}^- greatly influence the electrochemical phenomena involved in corrosion [2]. While efforts have been made to minimize corrosion in radiation environments through the selection of corrosion-resistant materials and continuous monitoring and control of the water environment in nuclear reactors, there is a need for ongoing research to monitor and test new materials [3]. The presence of high-energy gamma rays and neutrons presents numerous challenges for researchers, including the selection of suitable and radiation-resistant reference electrodes and the consideration of radiation safety. This presentation will delve into the reactions involved in electrochemical corrosion, the requirements for choosing electrodes, and provide an example of research conducted in this field.

Keywords: Irradiation Corrosion, Reference electrode, electrochemical corrosion potential (ECP).

References

[1] F. Schmidt, P. Hosemann, R.O. Scarlat, D.K. Schreiber, J.R. Scully, B.P. Uberuaga, Annu. Rev. Mater. Res. 51(1) (2021) 293.
[2] S. Le Caër, Water. 3(1) (2011) 235.
[3] M. Bagherzadeh, M. Karimi, M.H. Choopan Dastjerdi, M. Asadi Asadabad, J. Mokhtari, A. Babanejhad, Sci. Rep. 13(1) (2023) 17007.

آبکاری فلزات گرانبها و گروه پلاتینیم

دکتر امین حکیم زاده

شرکت دانش بنیان یکتا مبدل

E-mail address: aminhakimizad@gmail.com

آبکاری فلزات گران‌بها از جمله طلا (Au)، رودیوم (Rh)، روتنیوم (Ru) و پلاتین (Pt)، نقش مهمی در صنایع مختلف به‌ویژه در الکترونیک، جواهرات، تولید کاشتنی‌های پزشکی و مواد زیست‌سازگار ایفا می‌کند. در این ارائه، در گام اول مقدماتی در رابطه با اصول اولیه آبکاری الکتریکی مطرح می‌شود. سپس، فرآیندهای مختلف به‌کاررفته در این نوع پوشش‌دهی به‌ویژه در زمینه فلزات گران‌بها معرفی می‌گردد. روش آبکاری قلمی یا ماژیکی با کاربرد موضعی آن معرفی می‌شود که امکان دقت در جزئیات و تعمیر را فراهم می‌کند، سپس با روش غوطه‌وری که پوشش یکنواخت‌تری را برای پردازش انبوه سطوح ارائه می‌دهد، مقایسه می‌شود. در مورد مزایا و معایب هر دو روش مطالبی عنوان شده است که از جمله آن‌ها می‌توان به کارایی، مقیاس‌پذیری و کیفیت پوشش اشاره کرد.

فلزات گران‌بها ابتدا از جدول تناوبی عناصر معرفی می‌شوند. سپس دلایل ارزشمند بودن آن‌ها و نمودار تغییرات قیمت جهانی طی یک دهه اخیر آن‌ها به‌صورت خلاصه تحلیل می‌شود. سپس، طی جدولی برخی از مهم‌ترین خواص فیزیکی و مکانیکی آن‌ها مقایسه می‌شود. با تشریح مزایای پوشش‌های مبتنی بر این فلزات، کاربردهای اختصاصی هرکدام به‌طور مجزا عنوان می‌شود. همچنین، یک جنبه مهم از این ارائه به واکنش‌های شیمیایی اساسی درگیر در فرآیند آبکاری مرتبط می‌شود. بر این اساس، واکنش‌های الکتروشیمیایی احیاء که در کاتد در حین آبکاری الکتریکی اتفاق می‌افتند، به‌طور جداگانه برای هرکدام از فلزات فوق‌الذکر معرفی و تشریح می‌شود.

در این ارائه، علاوه بر مروری بر روش‌های سنتی آبکاری، روش‌های جدید آبکاری، به‌ویژه آبکاری با جریان پالسی معرفی می‌شود. این روش که خود متشکل از انواع پالسی تک‌قطبی و دوقطبی است، مزایای قابل‌توجهی را نسبت به آبکاری جریان مستقیم (DC) از خود نشان می‌دهد، مانند بهبود کنترل بر ویژگی‌های لایه‌نشانی، افزایش یکنواختی ضخامت، افزایش سختی، کاهش زبری و کاهش تنش داخلی در پوشش‌ها. با استفاده از آبکاری پالسی، تولیدکنندگان می‌توانند به خواص برتر در پوشش‌های آبکاری شده دست یابند که بر زیبایی، عملکرد و طول عمر محصولات نهایی تأثیر بسزایی می‌گذارد.

دکتر مهران جوانبخت
دانشکده شیمی – دانشگاه امیرکبیر

Alternatives of Lithium-Ion Batteries: Opportunities and Challenges

Mehran Javanbakht

Department of Chemistry, Amirkabir University of Technology, Tehran 1599637111, Iran

(E-mail address: mehranjavanbakht@gmail.com)

Abstract: Lithium-ion batteries (LIBs) are currently the dominant battery technology but there are the problem of the raw material dependencies. In addition to LIBs, there are at present many other alternative battery technologies that are still being developed or are about to enter the market. Therefore, this study focuses on those alternative battery technologies that seem promising for one or more applications with a more medium- to long-term perspective, especially on batteries that have not yet been commercially established on a large scale such as metal-ion batteries, metal-sulfur batteries, metal-air batteries and redox flow batteries. Alternative battery chemistries show first signal that they may become reality. They make use of abundant, cost-effective and non-toxic materials and have the potential to ease availability issues of critical raw materials and changed geopolitical dependencies.

Keywords: Alternative of Lithium-Ion Battery; Opportunities and Challenges; Zinc-Ion Battery; Sodium-Ion Battery.

دکتر بلال خلیل زاده
دانشگاه علوم پزشکی تبریز

Electrochemical biosensors for early-stage detection of silent diseases

Balal Khalilzadeh

Tabriz University of Medical Sciences

E-mail address: balalkhalilzadeh@gmail.com

Today, most types of cancers and also neurodegenerative diseases are categorized as silent diseases. Due to high mortality/morbidity of the silent diseases, early-stage evaluation of them has a critical role in public health and also it has socio/economic burden on the world. In this regard, design and development of novel technologies for sensitive, selective, fast response time and economic detection of these diseases is mandatory.

Electrochemical and electrochemiluminescence based biosensors are more sensitive methods for trace amount detection of disease biomarkers. By implementation of nanotechnology and application and advanced conductive and high surface area materials, we could improve the detection quantity/quality of target biomarkers. For this aim, we applied different metallic nanoparticles (gold, silver, platinum, palladium, wolfram, cadmium), biopolymers (poly taurine, poly glutamic acid), graphene and its derivatives, silica based micro-/meso-structures, mxene, perovskite and also combination of them for early-stage evaluation of most types of cancers (breast, colon, ovarian, colorectal, prostate) and Alzheimer diseases (tau protein and amyloid beta).

The developed biosensors could be applied as point of care (POC) devices for online monitoring of disease progress and also treatment strategies.

Prof. Richard N. Zare
Department of Chemistry
Stanford University, Stanford, CA, 94305, USA

Electrical Discharges Between Water Microdroplets in a Spray: A Possible Mechanism for Transforming Nonlife into Life on Early Earth

Richard N. Zare

Department of Chemistry
Stanford University
Stanford, California 94305 USA

The Earth is approximately 4.54 billion years old and was initially too hot to support life as we know it. As the planet cooled, the first signs of microbial life emerged around 3.5 billion years ago. But how did this transformation occur?

Our research focuses on understanding the processes that could transform simple abiotic gases, such as dinitrogen (N_2), methane (CH_4), carbon dioxide (CO_2), and ammonia (NH_3), into basic organic molecules containing carbon-nitrogen (C-N) bonds. These molecules are essential for the formation of amino acids, which are needed to create peptides and proteins, and nucleic acids, which are the building blocks of RNA and DNA. This presentation will propose a new mechanism for synthesizing the necessary components to create simple, single-celled living systems.

Oral Section

Design and fabrication of an electroforming machine to produce security holograms and improve their quality using nickel sulfamate solution

Javad Ghadimi[a,b]*, **Sara Asgari**[b], **Akbar Rezaei SarvOlya**[a] , **AliReza Zolfagharian**[a], **Babak Ebadi**[a], **Mahdi Piroozmand**[a]
[a]*Department of BioElectronic, PNR Co., Tehran, Iran*

[b]*Department of Research and Technology, Imam Khomeini Oil Refining Co., Arak, Iran*

**E-mail: j.ghadim68@gmail.com*

Abstract

Electroforming is defined as the fabrication of free-standing components using electrodeposition. Nickel electroforming has unique advantages, making it the only method to manufacture familiar products such as security holograms. The process route for hologram production involves the surface of the origination being coated with a very thin layer of metal to make it electrically conductive. Nickel metal is then electrodeposited onto this layer to produce a mechanically robust copy, perfect in detail, of the original image.

In this work, we designed and fabricated an electroforming machine to produce security holograms and improve their quality using the nickel-sulfamate solution. The as-built tub electroplating machine is made of a double-layer polypropylene which reduces corrosion against solutions and is non-conductive against electricity, and equipped with other equipment such as filters, pumps, voltage and current power supply, immersion heater with thermostat, anode basket, dummy cathodes, etc. Working with this machine is more convenient since it controls the process temperature, time, voltage, current, and circulation rate and determines the hardness and pH of the solution at any time [1]. The important parameters such as electrode distance are optimized for the best results.

The sulfate solution was also replaced with sulfamate solution due to its advantages like chemical constituents, additive-free system, and lower operational current and deposition time [2]. The 60% w/v nickel sulfamate solution was synthesized using sulfamic acid and nickel carbonate. The process was optimized to achieve a clear green-colored liquid with min. 11% w/v Ni content [3].

This system was specially designed for electroforming holograms using nickel sulfamate solution without any additives. At the end of the cycle, the holograms are flexible and removed from the shims easily and immediately.

Keywords: Electroforming, Security hologram, Nickel sulfamate, Electroplating tub

References

[1] Z. Rao, S.J. Hearne, E. Chason, *Journal of The Electrochemical Society*, 166 (2018) D3212-D3218.
[2] S. Roy, E. Andreou, *Current Opinion in Electrochemistry*, 20 (2020) 108-115.
[3] D. Baudrand, *Metal Finishing*, 94 (1996) 15-18.

Electrochemical deposition of metal oxide thin-layers on FTO glass for sensor applications

Hamid Dehghan-Manshadi[a], **Mohammad Mazloum-Ardakani**[b]*****, **Zahra Esmaeili**[b]

[a]*Thin Layer and Nanotechnology Laboratory, Department of Chemical Technologies, Iranian Research Organization for Science and Technology (IROST), P.O. Box 33535-111, Tehran, Iran*

[b]*Department of Chemistry, Faculty of Science, Yazd University, Yazd, Iran*

**E-mail: mazloum@yazd.ac.ir*

Abstract: Electrochemical deposition is a method for coating conductive/semi-conductive materials onto a conductive substrate using an electric field and redox reaction. This method is a high-performance technique in the design and preparation of selective surfaces for sensor applications [1]. One of the important biological markers in the human body is creatinine which has a useful role in the recognition of different kidney and cardiovascular diseases. The amount of creatinine in the blood serum of humans is commonly recognized as an indicator of renal health [2, 3]. In this work, an electrochemical deposition method based on isoelectric points of sensor components and creatinine was used to obtain a high-selective creatinine sensor. For this purpose, the surface of fluorine-doped tin oxide glass (FTO) was modified using reduced graphene oxide (rGO) and utilized as the substrate for electrodeposition of metal oxides on its surface according to dissimilarities in the isoelectric points of rGO (IEP=2.5) and metal oxide nanoparticles. Also, without metal oxide spaces were created by placing poly(vinyl alcohol) (PVA) strips on the substrate before electrodeposition and removing them after synthesis and stabilization of metal oxides. This hierarchical surface creates a good condition for adsorption of creatinine into rGO surface with dissimilar charge and interaction with metal oxides.

Keywords: Metal oxides, Thin-layer, Electrodeposition, Creatinine, FTO glass

References

[1] H. M. Saleh, A. I. Hassan. *Sustainability*, 15 (2023) 10891.
[2] H. Dehghan-Manshadi, M. Mazloum-Ardakani, S. A. Mozaffari. *Biosensors and Bioelectronics*, 246 (2024) 115881.
[3] S. Ghayempour, M. Mazloum-Ardakani, H. Dehghan-Manshadi, "Semiconducting Fibers for Sensors." In Semiconducting Fibers, *CRC Press* (2024) 152.

Investigating the stability of glucantime, an anti-leishmaniasis drug, using electrochemical methods

Armin Sadeghinia[a], **Seyedmousa Motavallihaghi,**[b] **Sajad Shanesaz,**[a] **Davood Nematollahi**[a,c*]

[a]*Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran*
[b]*Department of Medical Parasitology and Mycology, School of Medicine, Hamadan University of Medical Sciences, Hamadan, Iran*
[c]*Planet Chemistry Research Center, Bu-Ali Sina University, Hamedan, Iran*
[*]E-mail: a.sadeghinia@che.basu.ac.ir

Abstract: Leishmaniasis is a main global health concern, as the disease is widespread in 98 countries worldwide, with about two million new cases reported annually. Glucantime (*N*-methyl glucamine antimoniate) (meglumine antimoniate) is a pentavalent antimoniate is still the first line treatment and the choice medicine against leishmaniasis [1]. In this study, the cyclic voltammetry technique was used to investigate the stability of glucantime and the causes of the formation of antimony (III).

Background:

The use of antimony against leishmaniasis dates back to the 14th century. After that, the treatment of leishmaniasis with antimony (III) potassium tartrate started in 1913. However, due to the discovery of more effective and less toxic drugs prepared from pentavalent antimoniate, the use of trivalent antimonials was discontinued in the 1970s. finally, in this study, we decided to investigate the common opinion about the mechanism of side effects caused by glucantime drug, which is based on the presence of the Sb^{3+} species inside the solution.

Results:

Based on the obtained electrochemical data, it is clear that the glucantime drug complex has very good stability and Sb^{3+} species is not formed inside the drug solution.

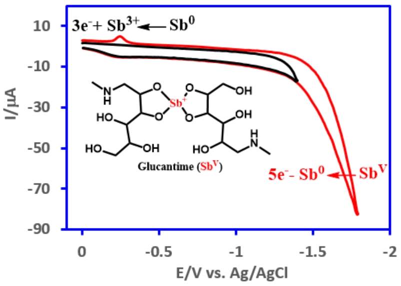


Figure 1. Cyclic voltammograms of glucantime (1.0 mM) at scan rate of 100 mV/s.

Significance:

In this study, one of the possible causes of side effects caused by Glucantime drug has been clarified.

Keywords: Glucntime, Cyclic voltammetry, Side effects.

References

[1] P. Salaün, F. Frézard, *Anal. Bioanal. Chem.* 405 (2013) 5201-5214.

Heteroatom doping of red phosphorus and sulfur in g-C_3N_4 and the combination with N-doping ZnO nanorods as a novel heterojunction and effective approach for developing photoanode in dye-sensitized solar cells

Fatemeh Shiravani, Javad Tashkhourian,* Omid Estakhr, and Amin Reza Zolghadr

Department of Chemistry, Faculty of Sciences, Shiraz University, Shiraz 71454, Iran
*E-mail: Mahsashiravani_97@yahoo.com

Abstract The non-renewable nature of fossil fuels poses a considerable challenge environmental threats. [1] The nature has conferred us a source of clean, free, and endless energy resources in the form of solar energy.[2] It is estimated that about 0.01% of the energy from one second of sunlight is sufficient for the annual energy consumption of human society; and can be converted into valuable electricity.[3],[4] In this work, a novel heterojunction of P, S-doped g-C_3N_4 with combination N-doped ZnO nanorods is reported for the first time as a highly effective photoanode electrode in dye-sensitized solar cell (DSSC). Phosphorous and sulfur doped g-C_3N_4 have been successfully synthesized by the facile eco-friendly thermally copolymerization of red phosphorus (RP) and urea. The synergistic effect of P, S-doped g-C_3N_4 in combination with the N-doped ZnO increases the surface area of ZnO and g-C_3N_4, which assists to dye uptake and faster electron transfer. The optimized DSSC based on NZnO-P-doped g-C_3N_4 (NZnO-PCN) photoanode shows J_{SC} ~20.50 mA cm^{-2}, V_{OC} ~0.67 V, fill factor (FF) ~0.64 and power conversion efficiency (PCE) ~8.8%. The power conversion efficiency was 7.3% for ZnO-P-doped g-C_3N_4 (ZnO-PCN), 5.8% for NZnO-S-doped g-C_3N_4 (NZnO-SCN), and 4.5% for ZnO-S-doped g-C_3N_4 (ZnO-SCN). Electrochemical studies including electrochemical impedance spectroscopy (EIS) and cyclic voltammetry (CV), confirmed that the remarkable improvement in the PCE of NZnO-PCN can be attributed to the combined effects of increased carrier concentration, morphology change, and enhanced Fermi energy level caused by N and especially RP doping in ZnO and g-C_3N_4, respectively.

Keywords: dye-sensitized solar cell, heteroatoms; graphitic carbon nitride; energy conversion; novel heterojunction

References

[1] K. Fan, J. Yu, W. Ho, *Mater. Horiz* **2017**, *4*, 319-344.
[2] W. S. W. Abdullah, M. Osman, M. Z. A. Ab Kadir, R. Verayiah, *Energies* **2019**, *12*, 2437.
[3] E. Fan, L. Li, Z. Wang, J. Lin, Y. Huang, Y. Yao, R. Chen, F. Wu, *chem. Rev* **2020**, *120*, 7020-7063.
[4] A. Rashedi, T. Khanam, *Environ. Sci. Pollut. Res.* **2020**, *27*, 29075-29090

Design and fabrication of electrochemical aptasensor on the electrode surface modified with nanocomposite for measuring of Avian influenza virus subtype H9N2 using fast Fourier transforms square wave voltammetry

Nogol Dianat Moghaddam[a], **Parviz Norouzi**[b]
[a]*Department of Chemistry, Faculty of Science, University of Tehran, Tehran, Iran*
[b]*Department of Chemistry, Faculty of Science, University of Tehran, Tehran, Iran*
[*]*E-mail:* nogolmoghaddam@ut.ac.ir

Abstract The H9N2 strain of the Avian Influenza is a concern in present time; as it has become dominant among humans, mammals, and poultry, and resulted in significant economic losses in the related industries [1, 2]; so, development of reliable devices for the strain's detection is a necessity. Aptamers, short single-stranded Nucleic Acids, have gained considerable popularity in the bio-sensing field due to their cost-effectiveness, specificity, and selectivity as biorecognition elements [3]. For the first time, we have fabricated a facile, rapid, and specific nanomaterial-based electrochemical aptasensor for the qualitative and quantitative measurement of the H9N2 virus; using Square-wave Voltammetry (SWV) technique.

A gold electrode was chosen as the primary transduction substrate, and was modified with Graphene Oxide (GO), Cerium(IV) Oxide (CeO_2) as a novel nanoparticle in bio-sensing applications, and Gold nanoparticles (AuNPs) to enhance the electrode's surface area, conductivity, and sensitivity [4]. After being cleaned, the electrode was modified with a composite solution of GO and CeO_2 powders and dried under an infrared lamp [5]. Subsequently, it was placed in a 0.1M PBS solution (pH = 6.5) containing 1mM $HAuCl_4 \cdot 3H_2O$ for one-step electrochemical reduction of both GO sheets and gold; leading to formation of AuNPs on its surface [5, 6].

In the next step, aptamer solution was incubated on the modified electrode and dried for 16 hours at 4°C; followed by incubation with 10^3 PFU/ml of the virus strain. After each step, the electrode was characterized in an aqueous solution containing 5mM $K_3[Fe(CN)_6]^{3-/4-}$ and 250mM KCl under optimized conditions.

Keywords: H9N2 Virus, Aptamer, Electrochemical Aptasensor, Nanoparticles, Square-wave Voltammetry

References

1. Hmila, I., et al., *A novel method for detection of H9N2 influenza viruses by an aptamer-real time-PCR.* Journal of Virological Methods, 2017. **243**: p. 83-91.
2. Sun, X., J.A. Belser, and T.R. Maines, *Adaptation of H9N2 Influenza Viruses to Mammalian Hosts: A Review of Molecular Markers.* Viruses, 2020. **12**(5): p. 541.
3. Amouzadeh Tabrizi, M. and P. Acedo, *An Electrochemical Impedance Spectroscopy-Based Aptasensor for the Determination of SARS-CoV-2-RBD Using a Carbon Nanofiber–Gold Nanocomposite Modified Screen-Printed Electrode.* Biosensors, 2022. **12**(3): p. 142.
4. Lee, C.-S., S.H. Yu, and T.H. Kim, *One-Step Electrochemical Fabrication of Reduced Graphene Oxide/Gold Nanoparticles Nanocomposite-Modified Electrode for Simultaneous Detection of Dopamine, Ascorbic Acid, and Uric Acid.* Nanomaterials, 2018. **8**(1): p. 17.
5. Nie, X., et al., *Sensitive and selective determination of tryptophan using a glassy carbon electrode modified with nano-CeO2/reduced graphene oxide composite.* Microchemical Journal, 2020. **159**: p. 105367.
6. Shen, M. and X. Kan, *Aptamer and molecularly imprinted polymer: Synergistic recognition and sensing of dopamine.* Electrochimica Acta, 2021. **367**: p. 137433.

Electrochemical late stage modification of clonazepam: A green strategy for the synthesis of sulfonamide derivatives

Zahra Godini,[a] **Davood Nematollahi**[*a,b], **Niloofar Mohamadighader** [a]

[a]*Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran*

[b]*Planet Chemistry Research Center, Bu-Ali Sina University, Hamedan, Iran*
[*]*E-mail: godini.zahra97@gmail.com*

Abstract: Synthesis of new pharmaceutical derivatives using last stage modification (LSM) of drugs has attracted our attention in this work [1,2]. We performed the electrochemical synthesis of new clonazepam (**CZP**) derivatives in the presence of arylsulfinic acid (**ASA**) derivatives. The electrochemical synthesis of these compounds has been carried out in an undivided cell equipped with graphite anode and stainless steel cathode in water/ethanol mixture under controlled potential conditions.

Background:

Clonazepam is a benzodiazepine used for diseases of the nervous system. Commonly used drugs such as clonazepam require the synthesis of new derivatives with the aim of improving performance in terms of effectiveness, and this made us determined to carry out this project and synthesize new derivatives of this drug.

Results:

In this work, we investigated the electrochemical behavior of clonazepam (Figure1) and performed the electrochemical synthesis of clonazepam in the presence of **ASA**. The clonazepam nitro group is reduced to the amine at the cathode (C_1), the amine is oxidized at the anode (A_1), and the final structure is formed in the presence of the **ASA** (Scheme1). We also performed molecular docking studies and obtained promising results.

Significance:

CZP derivatives were synthesized under facile and environmentally friendly conditions without the need for catalysts, reagents or toxic solvents.

Keywords: Electrochemical synthesis; Clonazepam; late-stage modification.

References

[1] Y. Wang, S. Dana and H. Long, *Chemical Reviews*, 123(2023) 11269
[2] D. Nematollahi, N. Mohamadighader and M. Roshani, *Electrochimica Acta*, 502(2024) 1447

Binary Metal Organic Frameworks Derived Hierarchical Hollow microspheres Ni/Co@Carbon composites as an efficient bifunctional electrocatalysts for Overall Water-Splitting

Laleh Sharif [a,b], Ali Benvidi [a,*], Sedigheh Zeinali [b] , Behzad Haghighi [c]

[a] Department of Chemistry, Faculty of Science, Yazd University, Yazd, Iran
[b] Nanochemical Engineering Department, Faculty of Advanced Technologies, Shiraz University, Shiraz, Iran
[c] Department of Chemistry, College of Sciences, Shiraz University, Shiraz, Iran

[*]E-mail: laleh.sharif@gmail.com & abenvidi@yazd.ac.ir

Abstract

Development of efficient, earth-abundant and low-cost electrocatalyst for effective water electrolysis is highly demanding for production of sustainable hydrogen energy. Recently, metal–organic frameworks as promising porous hybrid materials have been widely used in electrocatalytic applications [1-2].Herein, Binary Ni/Co MOFs with a hollow-sphere structure that is decorated with cone-shaped protrusions were prepared via a facile solvothermal reaction. Nickel nitrate and cobalt nitrate were used as a metal ion sources, while trimesic acid and PVP were used as the organic linker and the stabilizing agent to help the formation of a regular spherical structure for the growth of MOFs, respectively. In order to overwhelm the poor electrical conductivity, the as-synthesized Ni/Co-BTC MOFs precursor was carbonized to obtain hollow sphere Ni/Co@Carbon composites. During this one-step annealing strategy, the Ni, and Co ions were converted into metallic Ni, and Co nanoparticles and the organic ligands of the Binary Ni/Co MOFs were pyrolyzed into highly graphitized carbon layers, respectively. Afterwards Ni/Co@Carbon composites modified glassy carbon electrode showed superior OER and HER activity in 1 M KOH solution.

In summary, the superior OER and HER catalytic performance of Ni/Co@C composites can be ascribed to its spherical hollow structures, and multicomponent synergistic effects, which provide amount of accessible active sites. Remarkably, the hollow interior leads to fast mass transport, improving conductivity and expediting electronic transfer.

Keywords: metal-organic frameworks, Overall water splitting, Bifunctional catalyst

References

[1] S. F. Nami-Ana , S. Zeinali, *Applied Energy*, 350 (2023) 121755.

[2] A.Hanan, M. Lakhan, F. Bibi , A. Khan , I. Ali Soomro, A. Hussain, Umair Aftab, *Chemical Engineering Journal* 482 (2024) 148776.

Next-Generation Photo-Electrochemical Advanced Oxidation for High-Performance Water Pollutants Removal

Afsaneh Azhdeh[a], **Mohammad Hossein Mashhadizadeh** [a, b]*

[a]*Department of analytical Chemistry, Faculty of chemistry, Kharazmi University, Tehran, Iran*

[b] *Research Institute of Green Chemistry, Kharazmi University, Tehran, Iran*

**E-mail: Afsaneh.azhdeh@gmail.com*

Abstract Existing wastewater treatment methods using Fenton reaction (EF) have limitations like high cost for H_2O_2 and iron salts, operational complexities, and sludge generation [1]. To address these issues, research has explored heterogeneous photo-electro Fenton-like (HPEFL) systems utilizing readily removable Fe^{3+} and in-situ H_2O_2 generation via electric current, paving the way for a simpler and more efficient approach [2]. This research proposes a novel wastewater treatment method using a wireless electrochemical system [3]. It integrates HPEFL and PEC processes within a single cell. The cathode is made of MIL-53(Fe)/g-C_3N_4 and the anode is N-TiO_2/graphite. By applying wireless electric fields and light, these processes synergistically degrade pollutants. This approach achieved high removal efficiency (TOC 93%, COD 97%) within 35 minutes, surpassing traditional methods. The wireless system also simplifies operation and reduces energy consumption. The performance of HPEFL and PEC processes in the wireless system is influenced by external bias potentials.

To investigate this effect, we systematically studied the evolution of reactive oxygen species and the behavior of wireless electrode species. Cathode Reactions: On the cathode surface, two primary reactions occur: (1) iron reduction in MIL-53(Fe) and (2) oxygen reduction reaction (ORR) catalyzed by g-C_3N_4. Additionally, MIL-53(Fe^{3+}) can be regenerated on the cathode. Anode Reactions: Under visible light irradiation, MIL-53(Fe^{3+}) can be stimulated to generate electron-hole pairs. The generated electrons can contribute to diazinon removal by reacting with H_2O_2 to produce hydroxyl radicals or by reducing Fe^{3+} to Fe^{2+}. However, photo-generated holes may have a minor impact on diazinon removal.

On the surface of the wireless photo-electro anode, light irradiation causes electrons to be transferred from the valence band (VB) to the conduction band (CB) of N-TiO_2. The holes produced in the valence band can react with water molecules to generate oxidative species like hydroxyl radicals The wireless photo-electro anode and cathode generate oxidative species, such as hydroxyl radicals, which can subsequently attack diazinon.

Keywords: wireless electrochemistry, advanced oxidation process, wastewater treatment, diazinon, water pollutants.

References

[1] Moreira FC, Boaventura RAR, Brillas E, Vilar VJP. Appl Catal B 202 (2017) 217–261.
[2] Liang D, Li N, An J et al. Sci Total Environ 753 (2021)141809.
[3] Mashhadizadeh MH, Azhdeh A, Moazami HR, Sheydaei, M. Electrochim Acta 391 (2021) 138991.

Development of a High-Capacity Supercapacitor Electrode through Electrodeposition of MnO_2 on Vertically Aligned Graphene-Graphite Substrate

Pouya Abedi[a], **Mohammad Kazemzadeh**[a], **Atefeh Abin**[b], **Khalil Farhadi**[a]*

[a]*Department of Analytical Chemistry, Faculty of Chemistry, Urmia University, Urmia, Iran*

[b]*Department of Physical Chemistry, Faculty of Chemistry, Urmia University, Urmia, Iran*

**E-mail: khalil.farhadi@yahoo.com; pouyaabedi72@gmail.com*

The focus on supercapacitors as energy storage solutions has grown due to their impressive power density and extended lifespan [1]. A novel electrode design using MnO_2@VAG@Graphite has been developed, featuring a remarkably large surface area and exceptional capacitive performance achieved through a combination of graphite anodization and electrodeposition techniques [2]. In this research, a cutting-edge approach was employed to enhance the properties of a graphite sheet-based electrode. The aim was to boost porosity and conductivity through anodization, paving the way for the creation of Vertically Aligned Graphene (VAG) structures integrated with MnO_2 nanosheets [3]. The deposition of MnO_2 onto the VAG was accomplished using an innovative electrosynthesis technique. The resulting nanoarray configuration boasts a significant specific surface area and enhanced channels, facilitating swift ion transport and electron movement between the electrolyte and electrode. Interestingly, the process of anodizing graphite sheets not only improved electrode conductivity but also created additional active sites for MnO_2 adhesion [4]. The electrochemical performance of proposed electrode was outstanding, demonstrating remarkable specific capacitance and robust cycling stability. This method presents a compelling approach for the development of high-performance supercapacitor electrodes, characterized by improved porosity and surface area. The MnO_2@VAG@Graphite electrodes exhibited an exceptional capacitance of approximately 1249 F g^{-1} at a current density of 1 A g^{-1}, along with an impressive energy density of 314.93 $WhKg^{-1}$ and a power density of 12139.4 WKg^{-1}. Moreover, they maintained a stable capacity of around 95.8% after 1,000 cycles in the Cyclic voltametry.

Keywords: Supercapacitor, MnO_2, Vertically Aligned Graphene, Electrosynthesis

References

[1] B.S. Singu, U. Male, S.E. Hong, K.R. Yoon, *Ionics 22*,**2016**,1485.
[2] G. Wang, L. Zhang and J. Zhang, *ChemSoc- Rev*,**2012**, 797.
[3] A.K. Samantara, S. Ratha, *Springer Singapore*,**2014**.
[4] X. Lu, F. Zhang, H. Dou, C. Yuan, S. Yang, L. Hao, L. Shen, L. Zhang, *Electrochim. Acta*, 69 ,**2012**, 160.

Design and fabrication of an electrochemical-based PANI@V_2C-AuNPS MXene Quantum Dot immunosensor for detection of prostate cancer biomarker in Human Serum

Mohammad Safarpoor [a*], **Rassoul Dinarvand**[a], **Mehrorang Ghaedi** [b], **Arash Asfaram** [c]

[a] *Nanotechnology Research Center, Faculty of Pharmacy, Tehran University of Medical Sciences, Tehran, Iran*
[b] *Department of Chemistry, Yasouj University, Yasouj, Iran*
[c] *Medicinal Plants Research Center, Yasuj University of Medical Sciences, Yasuj, Iran*
[*]*E-mail: safarpoormohamad@yahoo.com*

Abstract

Background:

MXenes, being novel two-dimensional 2D substances, have generated significant interest due to their outstanding electrical conductivity, chemical resilience, and plentiful active catalytic sites [1,2]. PSA is a type of glycoprotein found in human prostate tissue. Its elevated levels above 10 ng mL-1 are associated with a marker for prostate cancer [3]. Consequently, it is essential to have a rapid, sensitive, selective, and precise monitoring system for PSA in biological samples to facilitate the early detection, treatment, and management of prostate cancer. The fabrication of a PANI@V2C-AuNPs MXene electrochemical immunosensor may face several challenges such as controlling the reproducibility and repeatability of the sensor fabrication process, as well as ensuring the long-term stability and durability of the sensor for reliable and accurate immunosensing applications.

Results:

Immunosensing in phosphate buffer pH 7.0 by DPV. The sensor with a linear range of 0.002 to 2 pg/mL demonstrates a wide range of sensitivity for detecting analytes. This sensor is capable of detecting small quantities of analytes with high precision. Moreover, the detection limit of 0.15 femtogram/mL further showcases the sensor's ability to detect ultra-low concentrations of substances. Overall, this sensor holds tremendous potential for accurate and sensitive detection in various applications.

Significance:

The design and fabrication of this electrochemical-based PANI@V2C-AuNPS MXene Quantum Dot immunosensor represent a significant advancement in cancer diagnostics, offering high sensitivity, a wide linear range, and ultra-low detection limits for the detection of prostate cancer biomarkers in human serum.

Keywords: Early detection of cancer, Prostate cancer, PANI@V2C-AuNPS MXene

References

[1] Li, Z.; Wu, F.; Yu, J.; Deng, Q.; Zhang, F.; Guan, W. Titanium Carbide (Ti3C2Tx) MXene: A Novel Precursor to Amphiphilic Carbide-Derived Graphene Quantum Dots for Fluorescent Ink, LightEmitting Composite and Bioimaging. *Carbon* 2017, 118, 50−57.

[2] Xie, X.; Zhao, M. Q.; Anasori, B.; Maleski, K.; Ren, C. E.; Li, J.; Byles, B. W.; Pomerantseva, E.; Wang, G.; Gogotsi, Y. Porous Heterostructured MXene/Carbon Nanotube Composite Paper with High Volumetric Capacity for Sodium-Based Energy Storage Devices. *Nano Energy* 2016, 26, 513−523.

[3] W.J. Catalona, P.C. Southwick, K.M. Slawin, A.W. Partin, M.K. Brawer, R. C. Flanigan, A. Patel, J.P. Richie, P.C. Walsh, P.T. Scardino, P.H. Lange, G. H. Gasior, K.G. Loveland, K.R. Bray, Comparison of percent free PSA, PSA density, and age-specific PSA cutoffs for prostate cancer detection and staging, *Urology* 56 (2000) 255–260.

Electrochemical sensor based on $H_3PW_{12}O_{40}$@CS-MWCNTs-βCD modified carbon paste electrode for determination of phenolic compounds

Jahan Bakhsh Raoof [a]*, Fatemeh Darvishnejad[a], Milad Ghani[b]

[a]Electroanalytical Chemistry Research Laboratory, Department of Analytical Chemistry, Faculty of Chemistry, University of Mazandaran, Babolsar, Iran
[b]Department of Analytical Chemistry, Faculty of Chemistry, University of Mazandaran, Babolsar, Iran

E-mail: fatemehdarvishnezhad@gmail.com

Abstract

Environmental pollutants, such as phenols and their derivatives are one of the most serious concerns that the world is facing and is considered a long-term threat to human development [1]. Given the harmful effects of this compounds, including chlorophenols (CPs) and aminophenols (APs), on human and animal health, many efforts have been made to various analytical methods for detection and measurement. Among the various reported methods for measuring environmental pollutants, electrochemical methods have received more attention than other methods [2]. The electrochemical methods have several advantages, including higher sensitivity, rapid measurement mechanisms with low limits of detection (LODs), fast reaction times, and simple and portable equipment for on-site application [3].

Herein, we designed a novel electrochemical sensor based on carbon paste electrode modified with polyoxometalates@carbon spheres-multiwalled carbon nanotubes and β-cyclodextrin composite ($H_3PW_{12}O_{40}$@CS-MWCNTs-βCD/CPE) for simultaneous determination of some phenolic compounds. In this method, differential pulse voltammetry was used to detect both 2-AP and 4-CP in environmental samples. Consequently, the differential pulse voltammetry displayed a wide two-step linear dynamic range (0.005-0.100 µM and 5-100 µM) with limits of detection (LODs) values ranging from 0.0014-0.0017 µM under optimal condition.

The electrochemical sensor exhibited excellent electrochemical performance, low LOD, wide LDR, high stability for simultaneous detection of 2-AP and 4-CP. Furthermore, the constructed electrochemical sensor showed good recovery percentage (97–112%) for 2-AP and 4-CP in different water samples. Therefore, the prepared electrochemical sensor has demonstrated excellent simultaneous analysis of 2-AP and 4-CP in various water samples.

Keywords: 2-Aminophenol, 4-Chlorophenol, Simultaneous determination, Polyoxometalates@carbon spheres

References

[1] O.M.L. Alharbi, R.A. Khattab, I. Ali, others, *Journal of Molecular Liquids*. 263 (2018) 442–453.
[2] V. Karthik, P. Selvakumar, P.S. Kumar, V. Satheeskumar, M.G. Vijaysunder, S. Hariharan, K. Antony, *Chemosphere*. 304 (2022) 135331.
[3] S. Fu, Y. Zhu, Y. Zhang, M. Zhang, Y. Zhang, L. Qiao, N. Yin, K. Song, M. Liu, D. Wang, *Microchemical Journal*. 171 (2021) 106776.

Development of a pH-sensitive smart anti-corrosion biocoating for magnesium alloys used in biomedicine

Sara Dehghan-Chenar, Hamid Reza Zare, Zahra Mohammadpour

Department of Chemistry, Yazd University, Yazd, Iran

[*]*E-mail: dehghansara42@gmail.com*

In recent years, there has been growing interest in the use of magnesium alloys for biomedical applications because of their excellent biocompatibility and mechanical properties [1-3]. However, a major limitation of magnesium alloys is their susceptibility to corrosion in physiological environments, which hinders their practical use [4]. To overcome this challenge, a pH-sensitive smart anti-corrosion bio-coating has been developed using a layer-by-layer technique. The first layer contains imidazole (ImH), a green corrosion inhibitor, encapsulated in a metal-organic frameworks. The second layer is composed of 1% w/v chitosan. The characteristics of the coating were analyzed using various techniques including SEM, EDS, FTIR spectroscopy, and XRD patterns. The corrosion parameters of the bio-coating were evaluated through potentiodynamic polarization plots and electrochemical impedance spectroscopy in simulated body fluid (SBF). The results showed that when the composite-coated magnesium alloy was immersed in SBF, the pH near the corrosion site gradually increased. This increase in pH leads to the release of imidazole as a corrosion inhibitor, which formed a protective layer on the alloy's surface, effectively preventing surface corrosion. The coating exhibited an inhibition efficiency of 97.27% after 5 days of immersion in SBF. Additionally, cell viability tests using the MTT assay showed significantly higher cell viability in the composite-coated magnesium alloy compared to the bare alloy, indicating a positive effect on the proliferation of MC3T3-E1 cells. The results demonstrated that the ImH@ MOF smart coating, which responds to changes in pH, effectively reduced corrosion of the magnesium alloy in the corrosive SBF environment.

Keywords: Green inhibitor. Imidazole. Smart anti-corrosion.

References

[1] V.V. Ramalingam, P. Ramasamy, M.D. Kovukkal, G. Myilsamy, *Metals and Materials International*, 26 (2020) 409-430.
[2] N. Li, Y. Zheng, *Journal of Materials Science & Technology*, 29 (2013) 489-502.
[3] V. Tsakiris, C. Tardei, F.M. Clicinschi, *Journal of Magnesium and Alloys*, 9 (2021) 1884-1905.
[4] G. Makar, J. Kruger, *International materials reviews*, 38 (1993) 138-153.

Microscale-Electroanalytical Lab in a Single Micropipette Tip for Electroanalysis of Nitrite Ions in Bio and Environmental Samples

Shohreh Madani [a], **Amir Hatamie [a] ***

[a] *Department of Chemistry, Institute for Advanced Studies in Basic Sciences (IASBS), Prof. Sobouti Boulevard, PO-Box 45137-66731, Zanjan, Iran.*

E-mail: (SM: shohreh.madani@iasbs.ac.ir, AH: amir.hatami@iasbs.ac.ir)

Abstract

In modern analytical chemistry, a key objective is to develop miniaturized, portable, and user-friendly sensing tools, particularly those with multitasking capabilities. In this work, we designed a microscale voltammetric cell that integrates metallic microelectrodes within a micropipette tip. This microscale voltammetric cell not only enables highly accurate micro-volume sampling but also performs electrochemical sensing rapidly.

The microscale cell was optimized for the analysis of nitrite ions in the ranges of 20-150 µM and 150-1200 µM, with a limit of detection (LOD) of 18.40 µM, meeting WHO and EPA standards. Additionally, it demonstrated high selectivity, stability (up to 36 continuous measurements with only 3.24% error), and repeatability (RSD of 2.98% for n = 15). This portable, easy-to-use device requires only a small sample volume (around 20-40 µL) for in-situ sampling and analysis.

The device's analytical performance was assessed by sampling and analyzing nitrite ions in various contexts: urine samples (for the fast diagnosis of urinary tract infections, where nitrite serves as a biomarker), river water samples (where nitrite is a pollutant of concern), and on contaminated hands (important in criminal investigations and forensic science, where nitrite indicates gunshot residue on a suspect's hand). The standard addition method yielded acceptable results across all matrices. These findings demonstrate the tool's effectiveness in nitrite analysis and suggest its high potential for microanalysis of other targets with further modifications in the future.

Keywords: Microscale electrode, Micropipette, Electroanalysis, Nitrite Ions

References

[1] S. Cinti, V. Mazzaracchio, G.Öztürk, D. Moscone, and F. Arduini. *Analytica chimica acta* 1029 (2018): 1-7.
[2] S.Cinti, R. Marrone, V. Mazzaracchio, D. Moscone, and F. Arduini, et al. *Biosensors and Bioelectronics* 165 (2020): 112334.
[3] F. de Oliveira, , E. Isaias de Melo, and R. Amorim Bezerra da Silva. *Sensors and Actuators B: Chemical* 360 (2022) 131650.

Single-Cell Amperometry Uncovers Impaired Pore Expansion Restricts Insulin Exocytosis in Human Type 2 Diabetes

Amir Hatami, [*a,b,c]

[a] *Metabolic Research Unit, Department of Physiology, Sahlgrenska Academy, University of Gothenburg, Gothenburg (Sweden).*
[b] *Department of Chemistry, Institute for Advanced Studies in Basic Sciences (IASBS), Zanjan 45137-66731, (Iran).*
[c] *Department of Chemistry and Molecular Biology University of Gothenburg, Gothenburg (Sweden).*
[*] *E-mail:* amir.hatami@iasbs.ac.ir,amirhatchem@yahoo.com

Abstract

Insulin secretion from vesicles within pancreatic beta cells occurs through the rapid (≤10 milliseconds) process of exocytosis. [1-3] A critical final step in this process is the formation of nanoscale fusion pores that connect the interior of the insulin vesicle to the extracellular space. We employed single-cell amperometry (SCA) with a microelectrode to measure serotonin secretion from single exocytosis events and simultaneously monitor fusion pore dynamics. Additionally, we used TIRF microscopy for vesicle imaging.

With these sensitive analytical tools, we investigated the amount of serotonin (used as a proxy for insulin [2]) released, the dynamics of nanoscale fusion pore formation (including opening, duration, and closing times), with diameter lower than 10 nm, during single-vesicle exocytosis events in real-time, and the number of vesicles docked to the cell membrane in individual human pancreatic beta cells from both healthy donors and those with type 2 diabetes (T2D).

For the first time, we found that the fusion pore opening rate at cell membrane is damaged in human T2D cells, leading to reduced vesicle content release to extracellular space. Our optical and electrochemical data highlight a link between defective fusion pore dynamics and reduced insulin secretion, a hallmark of T2D. Notably, this defect was observed in islets from every T2D human donor. As a result, this finding is significant for current diabetes research and treatment, as it could uncover a new aspect of beta cell performance in T2D.

Keywords: Single-Cell Amperometry, Microelectrode, Diabetes, Pore, Insulin Exocytosis

References

[1] A. Hatamie, X. He, X. W. Zhang, P. E. Oomen, and Andrew G. Ewing. *Biosensors and Bioelectronics* 220 (2023): 114899.
[2] A. Hatamie, L. Ren, H.Dou, N. R. Gandasi, P. Rorsman, and A. Ewing. *Angewandte Chemie* 133, no. 14 (2021): 7671-7674.
[3] K. Hu, R.Jia, A. Hatamie, K. Long Le Vo, M.V. Mirkin, and A. G. Ewing. Journal of the American Chemical Society 142, no. 40 (2020): 16910-16914.

Electrochemical synthesis of zinc-based MOF for corrosion applications

Razieh Sobhi Amjad[a]*, Sadegh Khazalpour[a], Seyed Javad Ahmadi[b], Mustafa Aghazadeh[b], Hamzeh Foratirad[b]

[a]*Department of Analytical Chemistry, Faculty of Chemistry, Bu-Ali Sina, Hamedan, Iran*

[b]*Nuclear Fuel Research School, Nuclear Science and Technology Research Institute, Tehran, Iran*

**E-mail: razieh.amjad88@gmail.com*

Abstract

Background:

Today, corrosion has become a big challenge in various industries. The use of coating is a common method to reduce the corrosion rate and increase the corrosion resistance of metals in corrosive environments. But these methods have disadvantages such as need for advanced equipment and long reaction time [1]. Nowadays, the use of green and environment-friendly methods and materials has attracted the attention of researchers. Metal-organic frameworks are a class of porous materials that are formed by the interaction between metal ions and organic ligands. Electrochemical method has attracted attention due to shorter synthesis time, easy operation, lower cost and direct deposition of MOFs on different substrates [2].

Results:

Morphological characterization showed Zn-MOF rod structures uniformly distributed on the surface. Polarization results show that the corrosion current density and corrosion potential changed to a lower current density and higher positive potential with the synthesis of Zn-MOF thin film on the substrate.

Significance:

In summary, we used a simple electrochemical deposition technique to manufacture Zn-based metal-organic framework thin films. The results obtained from XRD and SEM techniques proved the successful synthesis of Zn-MOF thin film on CS substrate. The results of electrochemical tests in 1M HCl solution showed that Zn-MOF thin films show good performance in corrosive environments and and effectively lower the rate of corrosion.

Keywords: Electrochemical deposition, Metal-Organic Framework, Corrosion

References

[1] L. Jiang, Y. Dong and X. Zhou, *Chemical Engineering Journal*, 430 (2022) 132822.
[2] T. Pham-Truong, H. Guemiza and H. Lavilluni`ere, *Electrochimica Acta,* 44 (2023) 141792.

Poster Section

The application of electrophoresis in determining the effectiveness of hesperidin against MCF7 cells in the management of ER^+ breast cancer treatment

Ramin Vosooghi[a], Alireza Motavalizadehkakhky[b]*, Atena Mansouri[c], Jamshid Mehrzad[a], Masood Homayouni[d]

[a] *Department of Biochemistry, Faculty of Science, Neyshabur Branch, Islamic Azad University, Neyshabur, Iran*

[b] *Department of Chemistry, Neyshabur Branch, Islamic Azad University, Neyshabur, Iran*

[c] *Cellular and Molecular Research Center, Birjand University of Medical Sciences, Birjand, Iran*

[d] *Department of Biology, Mashhad Branch, Islamic Azad University, Mashhad, Iran*

* *E-mail: amotavalizadeh@yahoo.com*

Background:
Breast cancer is the most common cancer among women in the world [1,2]. Studies have shown that hespertin has an effect on intracellular kinase pathways. Therefore, the purpose of this study is to culture cells, treat them with the desired drug, measure the number of destroyed cells using the MTT test and ELISA, and prepare cell extracts and measure the amount of proteins using the calibration curve, and then molecular separation, measure their weight, and identify them with The use of electrophoresis, a powerful Western blot method, was used to confirm the expression and transfer of proteins by direct flow and staining of protein spots, drawing curves.

Results:
Based on statistical curves, the results of this study showed that hespertin reduces the survival of MCF-7 cells in a dose- and time-dependent manner.

Significance:
Based on the findings of this study, it can be concluded that hespertin has an effect on ER expression, phosphorylation and activity through protein kinase pathways.

Key words: hespertin, estrogen receptor alpha, breast cancer

References

[1] A. Thejaswini Venkatesh, B. Sanu Thankachan, C. Shama Prasada Kabekkodu, D. Shrijeet Chakraborti and E. Padmanaban S. Suresh, *Epigenetics and Reproductive Health*, 21 (2021) 295.

[2] A. Fereidoon Shahidi, B. Vegneshwaran Vasudevan Ramakrishnan and C. Won Young Oh, *Journal of Food Bioactives*, 8 (2019) 6.

New insights into the electrochemical oxidation of bromothymol blue and bromophenol blue in aqueous solutions

Aram Moshrefi,[a] Mohammad Mehdi Hashemi-Mashouf,[a] Davood Nematollahi,[a,b*] Zahra Godini[a]

[a]*Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran*
[b]*Planet Chemistry Research Center, Bu-Ali Sina University, Hamedan, Iran.*
[*]*E-mail: arammshrfy@gmail.com*

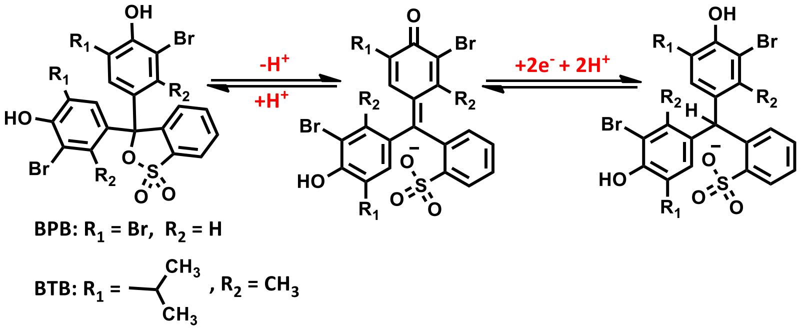
Abstract: Bromothymol blue (BTB) and bromophenol blue (BPB) are used as pH indicators, electrophoretic color indicators and industrial dyes. In this work, the electrochemical oxidation of bromothymol blue (BTB) and bromophenol blue (BPB) was studied by cyclic voltammetry and other voltammetric techniques. The result of this research provides a set of detailed, comprehensive and new information on the oxidation of these dyes, which has not been reported so far. The results of this research show that the electrochemical behavior of these two dyes follows a complex pattern and has similarities as well as differences. The results show that the number of peaks and their reversibility depend on the type of dye, potential scan rate, potential scan direction and solution pH.

Background:

Although the electrochemical behavior of BTB and BPB has been reported in some papers [1,2], however, these investigations are limited. Therefore, we decided to investigate the electrochemical behavior of these dyes completely and comprehensively.

Results:

The simplified mechanism of the redox reaction of BTB and BPB is shown in Scheme 1.



Scheme 1. The simplified reaction mechanism of BTB and BPB.

Significance:

This work provides new insight into the redox behavior of bromothymol blue and bromophenol blue in aqueous solutions.

Keywords: Electrochemical behavior, Bromothymol blue, Bromophenol blue, Reaction mechanism.

References

[1] G.J. Yang, X.L. Qu, A.P. Zhu, C.Y. Wang, Q.S. Qu, X.Y. Hu, *J. Electroanal. Chem.* 604 (2007) 48-56.

[2] B.N. Chandrashekar, B.K. Swamy, K.V. Mahesh, U. Chandra, B.S. Sherigara Int. J. Electrochem. Sci. 4 (2009) 471-480.

Investigation of Changing the Concentration Ratio of Non-Electroactive to Electroactive Species in Electron Transfer Kinetics SAMs

Elahe Dehnari [a], **Davood Taherinia***[a]

[a] Chemistry Department, Sharif University of Technology, Tehran11155-9516, Iran
*E-mail: *taherinia@sharif.edu*

Abstract

Background:

In this work, the synthesis, characterization, and electrochemical analysis of ferrocene-terminated oligophenyleneimine (OPI1_Fc)-based self-assembled monolayers (SAMs) in the tetrabutylammonium hexafluorophosphate (NBu_4PF_6) electrolyte solution on the surface of Au electrode was investigated. At first, SAMs were deposited on the electrode surface by linking to 4-aminothiophenol; after that, their length was increased by consecutive elimination reactions. The electroactive species of ferrocene carboxyaldehyde (FcCHO) and the non-electroactive benzaldehyde (PhCHO) were chemically connected to the termination of the molecular layers attached to the electrode surface. The effect of the surface concentration of non-electroactive species on the kinetics of electron transfer has been investigated [1-3].

Results:

The influence of concentration change of non-electroactive species on electron transfer kinetic was explored using some electrochemical techniques including cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). The CV of the molecular wires terminated with variable concentration ratios of PhCHO to FcCHO was examined. EIS for molecular wires terminated with varied concentration ratios PhCHO to FcCHO was also discussed.

Significance:

Based on the result of this research, with increasing the concentration ratio of PhCHO to FcCHO, the difference in cathode and anode peak potential, and the value of surface coverage decreases, and the electron transfer rate constant increases. Therefore, the electron transfer kinetic improved with increased PhCHO concentration compared to FcCHO.

Keywords: Electrochemical analysis, Electron transfer kinetic, Ferrocene-terminated oligophenyleneimine, Self-assembled monolayers.

References

[1] A.L. Eckermann, D.J. Feld, J.A. Shaw and TJ. Meade, T. J. Electrochemistry of Redox-Active Self-Assembled Monolayers. *Coordination Chemistry Reviews*, 254 (2010) 1769−1802.

[2] P.K. Eggers, H.M. Zareie, M.N. Paddon-Row and J.J. Gooding, Structure and Properties of Redox Active Self-Assembled Monolayers Formed from Norbornylogous Bridges. *Langmuir*, 25 (2009) 11090− 11096.

[3] D. Tahernia, Investigation of the Interfacial Electron Transfer Kinetics in Ferrocene-Terminated Oligophenyleneimine Self-Assembled Monolayers, *Langmuir*, 36 (2020) 12572−12579.

A hybrid of Cu-based metal organic framework and nitrogen-doped ordered mesoporous carbon as electrocatalyst toward eCO$_2$RR

Shohreh Khaledian[a], Fahimeh Varmaghani[a,b]*, Babak Karimi[a,b]*

[a]Department of Chemistry, Institute for Advanced Studies in Basic Sciences (IASBS), Zanjan, 45137-66731, Iran

[b]Research Center for Basic Sciences & Modern Technologies (RBST), Institute for Advanced Studies in Basic Sciences (IASBS), Zanjan 45137-66731, Iran

**Email: f.varmaghani@iasbs.ac.ir, karimi@iasbs.ac.ir,*

Abstract Over-reliance of fossil fuels results in increasing global concentration of CO$_2$. Electrochemical CO$_2$ reduction reaction (eCO$_2$RR) has hastily garnered attention as a highly-coveted green strategy to produce high-value carbon-containing chemicals from CO$_2$ reduction [1]. Numerous constructive researches have been conducted to achieve efficient MOF-based electrocatalyst toward eCO$_2$RR as a result of crystalline porous morphology, tuneable structure by linker manipulation and ordered and well-defined lattices [2]. In this direction, preparation hybrid of MOFs and carbonesous materials can be regarded as a propitious rout to overcome the drawbacks. Ordered Mesoporous Carbons have shown great promise in electrochemistry posing electrical conductivity, regular channels and active edge sites [3]. The current work was comprehensively evaluated a hybrid of guanine rich ionic liquid derived ordered mesoporous carbon (GIOMC) and Cu-based MOF (Cu-BTC@GIOMC) as electrolcatalyst toward eCO$_2$RR in a near natural aqueous solution. The robust interaction of the MOF and GIOMC, high nitrogen content of GIOMC, uniform distribution of the active metal centers, and high specific surface area achieved high current densities and suitable C$_1$ Faradaic efficiencies. GIOMC was synthesized by carbonizing a homogeneous mixture of 1-methyl-3-phenethyl-1*H*-imidazolium hydrogen sulfate as carbon sources in the presence of SBA-15 mesoporous silica as a hard scaffold. The structure of catalyst was characterized with SEM, XRD, Raman, FT-IR and TEM. Formic acid was produced in a high partial current density of 20 mAcm^{-2} at -0.72 V vs. RHE. Additionally, the efficiency of the catalyst was evaluated in nonaqueous solution. The resulted hybrid efficiently converted carbon dioxide to oxalic acid.

Keywords: Electrochemical CO$_2$ reduction reaction (eCO$_2$RR), Ordered Mesoporous Carbon (OMC), Metal Organic framework (MOF)

References

[1] Z. Peng, N. Deng, X. Li, H. Chi, H. Wang, W. Kang and B. Cheng, *Industrial and Engineering Chemistry Research*, 62 (2023) 21535.
[2] S.M. Hwang, S.Y. Choi, M.H. Youn, W. Lee, K.T. Park, A. Grace, S.K. Jeong, ACS Omega, 5 (2020) 23919.
[3] S. Barat-Abtahi, F. Jafari-Hafshejani, F. Varmaghani, B. Karimi, H. H. Veisi, Green Chemistry, 26 (2024)362.

Electrocatalytic behaviour of Zn-based MOF/ionic liquid derived ordered mesoporous carbon modified electrode for electrocatalytic reduction of carbon dioxide

Shakiba Omidi[a], Fahimeh Varmaghani[a,b]*, Babak Karimi[a,b]*

[a]*Department of Chemistry, Institute for Advanced Studies in Basic Sciences (IASBS), Zanjan, 45137-66731, Iran*

[b]*Research Center for Basic Sciences & Modern Technologies (RBST), Institute for Advanced Studies in Basic Sciences (IASBS), Zanjan 45137-66731, Iran*

**Email: f.varmaghani@iasbs.ac.ir, karimi@iasbs.ac.ir,*

Deep dependence of fossil fuels results in increasing energy crisis, rising sea level, global warming and disrupting carbon neutrality as a result of increasing of CO_2 concentration [1] Therefore, it is necessary to provide solutions to reduce carbon dioxide emission. Among current methodologies, electro-catalytic CO_2 reduction (eCO_2RR) is green and cost-effective method [2]. Serious limitations of eCO_2RR, however, include two-electron hydrogen evolution reaction (HER), low current density and selectivity, inadequate faradaic efficiency and high energy consumption. On the other hand, Metal Organic Frameworks (MOFs) are singular valuable microporous materials widely utilized in industrial process [3]. Alternatively, Ordered Mesoporous Carbon (OMC) exhibits superior chemical and electrochemical performance as a result of their unique properties derived from ordered pores of template [4]. These OMCs have several attractive features such as high accessible surface area, tunable porous structures, tailorable dopant configurations and chemical and thermal stability. In the current work a hybrid of Zn-based MOF/OMC was prepared as catalyst to modify electrode surface for CO_2 reduction. In this direction, OMC was fabricated by the carbonization of ionic liquid (1-methyl-3-phenethyl-1*H*-imidazolium hydrogen sulfate) using hard templating with ordered mesoporous silica SBA-15. Zn-MOF was uniformly anchored on carbon surface. The resulted modified electrode indicated suitable faradic efficiency for carbon monoxide. Carbon monoxide was produced in a suitable current density of 13 $mAcm^{-2}$ at an overpotential of 0.72 V vs. RHE.

Keywords: Electrochemical CO_2 reduction reaction (eCO_2RR), Ordered Mesoporous Carbons (OMCs), Zn-based Metal Organic framework (MOF)

References

[1] D. Johnson, Z. Qiao, A. Djire, *ACS Applied Energy Materials*, 4 (2021) 8661.
[2] R. Francke, B. Schille, M. Roemelt, *Chemical Review*, 118 (2018) 4631.
[3] C. Jing, J. Ma, Q. Sun, Y. Li, X. Tang, F. Ling, Y. Wang, Y. Zhang, X. Zhou, Y. Zhang, *CrystEngComm*, 25 (2023) 1941.
[4] S. Barat-Abtahi, F. Jafari-Hafshejani, F. Varmaghani, B. Karimi, H. H. Veisi, *Green Chemistry*, 26 (2024)362.

Electrochemical investigation of nickel oxide nanostructure on carbon fiber substrate as high performance supercapacitor electrode

G. Alaei[a], **M. Mazloum-Ardakani**[b]

[a]*Department of Chemistry, Faculty of Science, Yazd University, Yazd, 8915818411, Iran*

[*]*E-mail: alaeeghazale147@gmail.com*

Abstract: To date, for supercapacitors, there has been great interest in the development of commercial high-conductivity intermediate metal oxide electrodes such as CuO, Fe_3O_4, NiO, Co_3O_4, MnO_2, etc.[1].Among various transition metals, nickel oxide (NiO) with its environmental friendliness, high thermal stability, and abundant availability stands out as a highly efficient electrode material for supercapacitors. This work reported hydrothermal synthesis of NiO nanoparticles on the carbon fiber substrate as an electrode for energy storage devices. The electrochemical properties of the electrode were analyzed by a three-electrode system and CV, GCD and EIS electrochemical tests in the presence of 1M KOH electrolyte [2]. Cyclic voltammetry (CV) was performed at 0-0.7 V at different scan rates for the NiO/CFS electrode. The capacitance of the electrode NiO/CFS for each current density can be obtained by using galvanostatic charge-discharge (GCD) test. The galvanostatic charge-discharge (GCD) curves of the CFS and NiO/CFS electrodes measured at 0 to 0.57 V at 1 $A.g^{-1}$. In addition, electrochemical impedance spectroscopy (EIS) was performed to compare the charge transfer resistance(R_{ct}) of the two surfaces (NiO/CFS and CFS) [3,4]. The results showed a high capacitance of 852.547 $F.g^{-1}$ at 1 $A.g^{-1}$, good reversibility, high cycle stability and low charge transfer resistance for the NiO/CFS electrode. So NiO can be used as a promising electrode material for supercapacitors.

Keywords: Supercapacitor; One-pot hydrothermal synthesis; Nickel oxide nanostructure

References

[1] M. Mazloum-Ardakani, F.Sabaghian, M.Yavari, A.Ebady and N.Sahraie, *Journal of Alloys and Compounds* 819 (**2020**) 152949.

[2] S.Muduli, S. K.Pati, T. K. Pani and S. K. Martha, *Journal of Energy Storage* 66 (**2023**) 107339.

[3] M. Bonomo, *Journal of Nanoparticle Research* 20 (**2018**) 222.

[4] V. R. Channu, R.Holze and B.Rambabu, *Colloids and Surfaces A: Physicochemical and Engineering Aspects* 414 (**2012**) 204.

Design Of A Non-Enzymatic Electrochemical Sensor For Glutamate Detection Using Cobalt Based Metal-Organic Framework/Graphene Oxide Composite

Shiva Houshmand[a], Mohammad Mazloum-Ardakani[b]*, Hamideh Mohammadian-Sarcheshmeh[c], Fereshteh Mohseni-Sardari[d]

**Department of Chemistry, Faculty of Science, Yazd University, Yazd, Iran.*

* *E-mail address:* shiva.houshmand.1998@gmail.com

Abstract: Glutamate (Glu), an essential excitatory neurotransmitter in the brain, plays a vital role in human metabolism. However, abnormal Glu levels have been associated with various neurological disorders, such as Alzheimer's disease, stroke, Parkinson's disease, schizophrenia, and epilepsy. Therefore, accurately monitoring Glu levels is crucial in medical and food processing applications [1]. Metal-Organic Frameworks (MOFs) possess inherent versatility, exceptional porosity, and high surface area, making them highly sought-after materials for diverse scientific and industrial applications [2]. Recent research has focused on incorporating graphene oxides (GOs) and their nanocomposites in sensor fabrication, leading to significant improvements in electrochemical performance [3]. In this work, a novel electrochemical sensor for glutamate detection was developed using a cobalt-based Metal-Organic Framework/graphene oxide composite on a glassy carbon electrode, offering enhanced sensitivity for improved monitoring of glutamate levels. The structure and properties of the sensor were characterized using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FT-IR), and scanning electron microscopy (SEM). The resulting structure features randomly distributed rhombidodecahedron ZIF-67 nanocrystals with regular facets anchored onto the surface of the graphene sheets. The sensor displayed excellent selectivity towards glutamate in the presence of common interfering substances found in bodily fluids. Differential pulse voltammetry (DPV) analysis revealed a linear response in the micromolar range from 20.0 to 1000.0 µM within an alkaline solution. The detection limit (LOD) was determined to be 3.1 µM. The sensor has garnered significant attention due to its remarkable features, including excellent selectivity and high sensitivity.

Keywords: Neurotransmitter, Electrochemical Sensor, Glutamate

References

[1] Z. Alizadeh, M. Mazloum-Ardakani, F. Asadpour and M. Yavari, *ACS Applied Materials & Interfaces*, 15 (2023) 59246.

[2] F. Farbod, M. Mazloum-Ardakani, H. R. Naderi, A. Mirvakili, M. Wang, D. V. Shinde, S. Dante, P. Salimi, S. Lauciello and M. Prato, *Journal of Energy Storage*, 51 (2022) 104238.

[3] F. Jokar, H. Mohammadian-Sarcheshmeh, B. B. F. Mirjalili and S. S. Hosseinikhah, *Iranian Journal of Analytical Chemistry*, 8 (2021) 15.

Bubble Wall-Mediated Electrochemical Sensing and Deposition: Adventures in Electrochemistry

Nikoo Fahemi,[a] **Shayan Angizi**, [b] **Amir Hatamie** [a,c] *

[a] *Department of Chemistry, Institute for Advanced Studies in Basic Sciences (IASBS), Prof. Sobouti Boulevard, PO-Box 45195-1159, Zanjan, 45137-66731, Iran.*

[b] *Department of Chemical Engineering, McMaster University. Hamilton, Canada.*

[c] *Department of Chemistry and Molecular Biology, University of Gothenburg, Gothenburg, Sweden.*

**E-maill:* amir.hatami@iasbs.ac.ir, amirhatchem@yahoo.com, amir.hatami@gu.se)

Abstract: We present a novel electrochemical cell design with a thickness of approximately 30 µm, featuring a 10 µm carbon fiber electrode [1] inserted through a stable surfactant film made from Triton-X100. [2-3] This compact cell was used for electrochemical sensing on a hand and fingers, in a cell-free medium, and for microscale metallic electrodeposition for the first time.

For microelectroanalysis, a nanosheet graphene oxide-coated carbon microelectrode serves as the sensing electrode, positioned across a soap bubble wall containing dissolved nitrite ions (NO_2^-). A 1 mm diameter silver wire acts as the reference electrode on the bubble holder. The system detects dissolved NO_2^- on hands and within the surfactant film, making it valuable for criminal investigations by identifying gunshot residue, with a low detection limit of 28 µM in the range of 30–1500 µM. Nitrite serves as an indicator of shooting in forensic investigations. The technique is fast, cost-effective, and requires no sample preparation, making it ideal for rapid on-site police investigations.

In the study's second part, we explored micro-electrodeposition of dissolved silver and palladium ions within the bubble wall, resulting in microscale metallic film deposition on the inserted bare microelectrode. The thickness of the bubble wall (the electrochemical cell) determines the deposition area, enabling the development of a new, template-free micro-electrodeposition technique. SEM analyses revealed that the bubble wall's thickness limits the electrodeposition area, while its lifespan controls the film's thickness. Both the sensing and electrodeposition techniques are novel, and we believe this work open new window electrochemical science.

Keywords: Bubble Film, Electrochemical Sensing and Deposition, Microelectrode, Nitrite.

References

[1] X. Zhang, , A. Hatamie, , A. G. Ewing, *Current Opinion in Electrochemistry*, 22, (2020). 94-101.
[2] D. C. B. Braide-Azikiwe, K. B. Holt, David E. Williams, and Daren J. Caruana. *Electrochemistry communications* 11, no. 6 (2009): 1226-1229.
[3] Vannoy, Kathryn J., Nicole E. Tarolla, Philip J. Kauffmann, Rebecca B. Clark, and Jeffrey E. Dick. *Analytical Chemistry* 94, no. 16 (2022): 6311-6317.

Innovative Integration of Robotic and Printed Nanosensor for real –time Electrochemical Sensing in Surface and Underwater Environments

Shima Kamran Haghighi,[a] **Saba Mohamad Lo,**[a] **Shayan Angizi,** [b] **Amir Hatamie** [a,c] *

[a] *Department of Chemistry, Institute for Advanced Studies in Basic Sciences (IASBS), Prof. Sobouti Boulevard, PO-Box 45195-1159, Zanjan, 45137-66731, Iran.*

[b] *Department of Chemical Engineering, McMaster University. Hamilton, Canada.*

[c] *Department of Chemistry and Molecular Biology, University of Gothenburg, Gothenburg, Sweden.*

**E-maill:* (S. K.:shimakamran@iasbs.ac.ir),A.H: amir.hatami@iasbs.ac.ir,amirhatchem@yahoo.com)

Abstract Smart and remote sensing technologies have advanced in recent years [1-3]. In this study, we present an innovative approach that combines printed electrochemical sensors with a remotely controllable submarine robot to conduct on-site and real-time electroanalysis in natural water sources, such as deep-sea environments and surface rivers.

We began by fabricating a nano-conductive ink composed of graphite, silver nanorods (D: 40±10 nm, L: 5.0-1.0 µm) as a modifier, nail polish as a cheap adhesive, and acetone as a solvent. In this process, we optimized variables such as the graphite concentration and electrode thickness to achieve the best formulation with high conductivity. This nano-ink was then used to print electrochemical systems onto the body of the controllable submarine robot. The fabricated robot-sensor demonstrated a linear response to hydroquinone (HQ), an organic pollutant, in the range of 5.0-386.0 µM, and to nitrite ions, a critical ion in environmental analysis, in the range of 3.0-100.0 µM. We also assessed the repeatability (RSD <5%), selectivity, and stability of the sensor. In practical applications, first, the robotic sensor successfully detected chemical leakage from an underwater pipeline filled with HQ by performing underwater voltammetric analysis at various points along the pipeline. Secondly, it detected nitrite when the robo-sensor remained on the polluted surface water and in both cases, data were transmitted to an analytical unit outside of water environment.

This method reduces the time and cost associated with sampling while providing remote and real-time sensing capabilities in high-risk and hard-to-reach locations, such as deep-water environments.

Keywords: Electrochemical sensor, Smart and remote sensing, Nano-conductive ink.

References

[1] M. Zhou, T. Li, K. Fan, Y. Shu, P. Liu, and H. Zhao. *ACS sensors* 10, (2023) 3836.
[2] K. Sun, W. Cui, and C. Chen. *Sensors* ,21,(2021), 7849.
[3] C. Chen, A. Wiorek, A. Gomis-Berenguer, G. A. Crespo, and M. Cuartero. *Analytical Chemistry* 95, 8 ,(2023),4180-4189.

Development of a Molecularly Imprinted Electrochemical Sensor for Sensitive and Selective Quantification and Monitoring of Imatinib Release

Najva Sadri[a]*, **Mohammad Mazloum-Ardakani**[a]

[a]*Department of Chemistry, Faculty of Science, Yazd University, Yazd, Islamic Republic of Iran*

**E-mail: Najva.sadri.0226@gmail.com*

Abstract

Imatinib (IMA) is a leading tyrosine kinase inhibitor used in the treatment of chronic myeloid leukemia and gastrointestinal stromal tumors. However, IMA faces challenges such as drug resistance and significant interpatient pharmacokinetic variability. Moreover, low plasma levels of IMA may indicate ineffective treatment, necessitating careful monitoring of IMA concentrations in biological and pharmaceutical samples, so accurate measuring and investigating drug release profiles is essential for in vitro and in vivo tests. Recently, nanomaterials have been increasingly used for both measuring and controlling, targeted, and efficient drug release. In this study, we developed a sensitive and selective electrochemical sensor to measure IMA levels and monitor drug release in real-time. A core-shell molecularly imprinted polymer (IMA-MIP) was synthesized using 3-aminopropyltriethoxysilane (APTES) as the monomer and tetraethyl orthosilicate (TEOS) as the cross-linker, and IMA as the template molecule. This IMA-MIP was applied to a screen-printed carbon electrode (SPCE). The sensor selectively binds IMA through imprinted cavities and quantifies the trapped drug using differential pulse voltammetry. The sensor offers a wide linear range (1.0 – 700.0 µM) and a low detection limit (0.22 µM), showing excellent sensitivity and selectivity. It also demonstrates good repeatability and reproducibility, ensuring reliable performance across tests. The platform was successfully applied to measure IMA in blood serum and pharmaceutical samples, providing accurate results without the need for complex preparation. Additionally, the sensor facilitates real-time monitoring of IMA's drug release, offering valuable insights into its pharmacokinetics and potential for improving personalized treatment strategies.

Keywords: Electrochemical sensor, molecularly imprinted polymers, drug montoring, Imatinib

References

[1] M. Zindler, B. Pinchuk, C. Renn, R. Horbert, A. Dębber, C. Peifer, Design, *ChemMedChem*, 10 (2015) 1335.
[2] J.P. Besse, J.F. Latour, J. Garric, *Environ. Int.*, 39 (2012) 73.
[3] K. Elumalai, S. Srinivasan, A. Shanmugam, *Biomed. Technol.*, 5 (2024), 109.
[4] F. Vajhadin, M. Mazloum-Ardakani, S. Raeisi, M. Hemati, A. Ebadi, F. Haghiralsadat, D. Tofighi, *Colloids Surf. B Biointerfaces*, 220 (2022), 112870.

An electrochemical aptasensor based of glassy carbon electrode modified with Au-Cu doped NiCo-MOF hollow nanospheres for ultrasensitive detection of tryptophan

Seyedeh Masoumeh Mousavi [a]*, Jahan Bakhsh Raoof [a], Zeinab Rahmati[a]
[a]*Electrochemical Chemistry Reserch Laboratory ,Department of Analytical Chemistry, Faculty of Chemistry, University of Mazandaran, Babolsar, Iran*

**E-mail:* m.masoome.1998@gmail.com

Abstract

Tryptophan is an essential amino acid that plays a crucial role in the human body, including normal growth and nerve transmission [1]. Since the human body is unable to produce tryptophan, it is essential to include it in the diet [2]. It is noteworthy that excessive amounts of tryptophan in the body can cause adverse effects such as nausea, drowsiness, dizziness and loss of appetite [3]. Therefore, developing an accurate, fast and low-cost approach to detect tryptophan levels in the diet is crucial. In this regard, the use of electrochemical aptasensors is a suitable method due to its advantages [4].

In this work, the hollow nanospheres of NiCo-MOF was synthesized via solvothermal method. Subsequently, Cu and Au were added to the MOF to enhance its conductivity and facilitate the connection between thiol groups of the aptamer and nanoparticles placed on the surface of the glassy carbon electrode. After characterizations the synthesized compound, each construction step of aptasensor was investigated through $[Fe(CN)_6]^{3-/4-}$ probe using cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). The EIS results for calibration showed that the designed aptasensor has the ability to measure tryptophan in a linear concentration range of 0.5 fM to 200 nM with a detection limit of 0.14 fM.

According to the results, the prepared aptasensor exhibits a wide linear range, low detection limit, good repeatability with RSD = 1.37 % and stability. Finally, the ability of the proposed method was confirmed by measuring tryptophan in food samples such as wheat, chikpea and lentil.

Keywords: Tryptophan, NiCo MOF, Hollow nanospheres, Electrochemical aptasensor

References

[1] L. Li, Y. Luo, L. Jia, *Food Chem*. 407 (2023) 135125.
[2] F. Rezaei, N. Ashraf, G.H. Zohuri, *Microchem. J*. 185 (2023) 108260.
[3] L. Zhang, C. Li, Y. Chen, S. Li, X. Wang, F. Li, *Food Chem*. 458 (2024) 140309.
[4] C.C. Negut, R.-I. Stefan-van Staden, *J. Electrochem. Soc*. 168 (2021) 67517.

An innovative redox active hydrogel electrolyte with self-healing capability for wearable supercapacitors

Mohammad Barazandeh[a] **and Sayed Habib Kazemi**[a]*

[a]*Department of Chemistry, Institute for Advanced Studies in Basic Sciences (IASBS), Zanjan 45137-66731, Iran.*

E-mail: habibkazemi@iasbs.ac.ir

Abstract

The popularity of wearable, portable, and particularly flexible electronics is rapidly increasing. The exceptional mechanical resistance and bending flexibility, showcased by solid electrolytes, contribute significantly to their allure for use in the progression of wearable electronics [1,2]. These electrolytes offer the dual ability to function as the device' separator and ion conducting media; hence these qualities will significantly aid in the design of a range of hydrogel electrolytes in energy storage devices [3]. The emergence of wearable flexible electronic devices has driven the development of energy storage systems characterized by flexibility, high power density, mechanical resistance, and self-healing properties [4]. Flexible and self-healing supercapacitors have attracted the attention of many researchers because when damaged by bending or deformation, these supercapacitors can recover their capacitive capabilities [5]. Flexible and self-healing hydrogels are the cornerstone in the design of flexible supercapacitors. This work reports the fabrication of a redox-active and self-healing hydrogel electrolyte based on hydroxy acrylate and imidazolium derivatives for supercapacitor applications, both as the electrolyte and separator in a supercapacitor and demonstrated a specific capacitance of 110.94 F g^{-1} at a scan rate of 5 mV s^{-1}. The results of this study offer the fabricated hydrogel electrolyte as a promising prospect for use in flexible energy storage systems.

Keywords: Hydrogel electrolytes, Self-healing, Supercapacitors, Flexible, Wearable.

References

[1] M.R. Islam, S. Afroj, N. Karim, *ACS nano, 17 (2023) 18481-18493*.

[2] M.M. Amaral, R. Venancio, A.C. Peterlevitz, H. Zanin, *Journal of Energy Chemistry*, 67 (2022) 697-717.

[3] H. Peng, Y. Lv, G. Wei, J. Zhou, X. Gao, K. Sun, G. Ma, Z. Lei, *Journal of Power Sources*, 431 (2019) 210-219.

[4] V.-P. Vu, V.-D. Mai, D.C.T. Nguyen, S.-H. Lee, *ACS Applied Energy Materials*, 5 (2022) 2211-2220.

[5] Y. Cheng, X. Xiao, K. Pan, H. Pang, *Chemical Engineering Journal*, 380 (2020) 122565.

A flower-structured Nickel-based Metal−Organic Framework/MWCNTs nanocomposite-modified sensor for the sensitive electrochemical detection of glutamate

Fereshteh Mohseni-Sardari[a], **Mohammad Mazloum-Ardakani**[b]*,
Hamideh Mohammadian-Sarcheshmeh[c], **Zahra Alizadeh**[d], **Shiva Houshmand**[e]

[a-e]*Department of Chemistry, Faculty of Science, Yazd University, Yazd, Iran*

E-mail address: fereshtemohseni4425@gmail.com

Abstract. Neurotransmitters (NTs) are endogenous chemical messengers that neurons use to communicate with one another, act on muscle cells, or stimulate a response from glandular cells. Glutamate, a prominent neurotransmitter in the mammalian central nervous system, plays a vital role in various biological processes. Given the importance of monitoring glutamate levels in medical and food processing applications, the need for continuous and effective detection methods is paramount [1]. Over the last twenty years, metal-organic frameworks (MOFs) have emerged as significant advancements in porous materials. However, the instability of MOFs in aqueous solutions and their low conductivity have limited their application in electrochemical sensors [2]. To address this challenge, researchers have begun integrating highly conductive materials such as carbon nanotubes (CNTs) and metal nanoparticles into MOFs to enhance their electrical conductivity and electrochemical performance [3]. CNTs@MOF composite sensors have been utilized in clinical diagnostics to detect and track biomolecules, thereby contributing significantly to human health [4]. In this study, we fabricated a Ni-MOF-CNTs nanocomposite sensor for glutamate detection, aiming to create a sensitive and selective electrochemical sensor for practical biological applications. Our results demonstrated that the Ni-MOF-CNTs nanocomposite exhibited improved electrocatalytic activity toward glutamate oxidation compared to pure MOF or CNTs materials. The as-fabricated sensor displayed a wide linear range (150.0–4900.0 μM) and a low detection limit (69.9 μM, S/N = 3). These findings suggest that the Ni-MOF-CNTs nanocomposite-based sensor is a promising platform for developing of a robust, enzyme-free glutamate sensor.

Keywords: Nanocomposite, Neurotransmitters, Sensor

References

[1] Z. Tavakolian-Ardakani, O. Hosu, C. Cristea, M. Mazloum-Ardakani and G. Marrazza, *Sensors*,19 (2019) 2037.
[2] M. Mazloum-Ardakani, H. Mohammadian-Sarcheshmeh, H. Naderi, F. Farbod and F. Sabaghian, *Journal of Energy Storage* , 26 (2019) 100998.
[3] Y. Wang, L. Wang, H. Chen, X. Hu and S. Ma, *ACS Applied Materials & Interfaces* , 8 (2016) 18173.
[4] M.-Q. Wang, C. Ye, S.-J. Bao, Y. Zhang, Y.-N. Yu and M.-W. Xu, *Analyst* , 141 (2016) 1279.

Insight into the Role of Structure in Ordered Mesoporous Carbons for Electrochemical Applications

Zahra Sepehri[a], Fahimeh Varmaghani[a,b]*, Babak Karimi[a,b]*

[a] *Department of Chemistry, Institute for Advanced Studies in Basic Sciences (IASBS), Zanjan, 45137-66731, Iran*

[b] *Research Center for Basic Sciences & Modern Technologies (RBST), Institute for Advanced Studies in Basic Sciences (IASBS), Zanjan 45137-66731, Iran*

**Email: f.varmaghani@iasbs.ac.ir, karimi@iasbs.ac.ir,*

Ordered Mesoporous Carbons (OMCs) are uniquely valuable mesoporous materials widely utilized in electrochemistry. Numerous constructive researches have been conducted to develop efficient OMC-based electrocatalyst, owing to their regular structure of pores providing accessible channels for diffusion of electroactive species. The regular porous morphology outstands OMCs from other types of carbonaceous materials including mesoporous carbon (MC) [1]. Up to now striking efforts have been devoted to synthesis OMCs using various hard- and soft-templates [2]. In recent years, we have focused on nanocasting synthesis and versatile implications of ionic liquid derived ordered mesoporous carbons (OMCs) [3,4]. The properties of OMCs, such as surface area, pore volume, structural and physical characteristics are dependent on the kind of template. In this work, ordered mesoporous carbons were synthesized with the nanocasting process using different hard templates and their electrochemical performance were comprehensively studied. Morphology and structural properties of the obtained OMCs were studied using XRD, FT-IR, TEM and SEM techniques. The prepared ordered mesopores carbons with different meso-structural features exhibited different behavior for mass transfer and diffusion electrolyte ions and electro-active species. Additionally, compared with the 2D cylindrical mesoporous structure, the 3D interconnected pore channels indicated better activity in electrochemical studies.

Keywords: Ordered Mesoporous Carbon (OMC), Nanocasting method, Electrocatalyst

References

[1] A. Eftekhari, Z. Fan, *Materials Chemistry Frontiers*, 1 (2017) 1001.
[2] Z. Liu, Y. Du, P. Zhang, Z. Zhuang, D. Wang, *Matter*, 4 (2021) 3161.
[3] B. Karimi, H. Behzadnia, M. Bostina, H. Vali, *Chemistry - A European. Journal*, 18, (2012) 8634.
[4] N. Shamsvand, F. Varmaghani, B. Karimi, H. H. Veisi, *Analyst*, 148 (2023) 1309.

Molecularly imprinted electrochemical sensor based on Cu-MOF for sensitive detection of the Pregabalin

M. Jelvehzadeh[1], Kh. Ghanbari[1]*

[11]*Department of Analytical Chemistry, Faculty of Chemistry, Alzahra University, P. O. Box 1993893973, Tehran, Iran.*
*E-mail: kh.ghanbari@alzahra.ac.ir

Abstract

Pregabalin (PGB), a drug used to treat nervous system disorders, requires accurate dosage measurements for absorption, distribution, metabolism, and excretion [1, 2]. Various methods have been proposed for PGB measurement, including spectroscopic-based methods, HPLC, and LC-MS/MS. However, these methods have drawbacks such as complex sample preparation, high organic solvent use, and long analysis times. The use of molecularly imprinted polymers (MIP) in the design of electrochemical sensors offers advantages such as selective detection, high stability, and low preparation costs. Combining MIPs with metal-organic frameworks (MOFs) provides specific adsorption sites and large pores for effective adsorption and enhanced conductivity [2,3].

Here, a MIP-modified electrode with Cu-MOF was successfully prepared for the detection of PGB. For this purpose, first, the carbon paste electrode modified with a Cu-MOF (CPE/Cu-MOF) has been fabricated. The MIP was then synthesized on the surface of the CPE/Cu-MOF through the electro-polymerization of ortho-phenylenediamine in the presence of PGB molecules as matrix polymer, and template molecules, respectively. The template molecule removal was studied using different methods such as CV, EIS, SEM, EDX, and ATIR. Under the optimal experimental conditions, the method showed superior selectivity to PGB with three adynamic ranges in 0.003-0.09 µM, 0.1-1.0 µM, and 1.0-90.0 µM of DCF with a limited of detection (LOD) of 1.2 nM (S/N = 3). Cyclic voltammetry (CV) at various scan rates verified that adsorption kinetics follows a diffusion control mechanism. Finally, the efficiency of the CPE/Cu-MOF/MIP-POPD sensor in real samples was evaluated and satisfactory results were achieved.

Keywords: Molecularly imprinted polymer, Metal-organic framework, Electropolymerisation, Pregabalin.

References

1. N. Zalpour, M. Roushani, and H. Hosseini, Polydopamine imprinted polymer-based tunable electrochemical synthesis of copper benzene-1, 3, 5-tricarboxylate metal-organic framework film as a hybrid dual recognition element for ultra-trace sensing of pregabalin (lyrica). Sensors and Actuators B: Chemical, 370 (2022) 132418.
2. L. Shanshan, T. Liu, Y. Yi, B. Xie, H. Hou, A. Luo, A molecularly imprinted electrochemical sensor with tunable electrosynthesized Cu-MOFs modification for ultrasensitive detection of human IgG. Bioelectrochemistry 146 (2022) 108154.
3. H. Wang, L. Cai, Y. Wang, C. Liu, G. Fang, S. Wang, Covalent molecularly imprinted electrochemical sensor modulated by borate ester bonds for hygromycin B detection based on the synergistic signal amplification of Cu-MOF and MXene. Food Chemistry 383 (2022) 132382.

Application of glass carbon electrode modified by metal–organic frameworks for quantitative measurement of toxic compounds as Bisphenol A

Peyman Mohammadzadeh Jahani[a]*, Maedeh Jafari[b]
[a]*Department of Medicine, Bam University of Medical Sciences, Bam, Iran*
[b]*Department of Pediatrics, School of Medicine, Kerman University of Medical Sciences, Kerman, Iran*
*****Email : mjpeyman@yahoo.com*

Bisphenol A(BPA) normally exists in food packages, metal food containers, the lining of beverage cans, and clear shatterproof plastics exploited in rigid water bottles, tableware, small kitchen accessories, and baby bottles [1-3]. As such, the health of people might be negatively affected by BPA penetrating into the drinking water and food from product packaging. Some of the adverse impacts of low volumes of BPA include the formation of reproductive disorders, (such as the impaired brain development in humans, birth defects, and reduced sperm quality level) and different cancer types (such as testicular, breast, and prostate cancer).[4]Currently, electrochemical methods, gas chromatography, high performance liquid hromatography, spectrometry, fluorescence, mass, and chemiluminescence have been applied to determine BPA level in various samples.[5] However, the most efficient results for determining some environmental, pharmaceutical, and biological compounds have been obtained by electrochemical sensing techniques, which have many advantages, including the possibility to perform on-site measurement, portability, simple sample preparation, fast response, high sensitivity and low cost.[6] The MOF-508a was synthesized by dissolving benzne dicarbocsilic acid, bypyridin and zinc nitrate with ratio of 1:0.5:1 in 50 ml of DMFAfterwards, the solution was refluxed at 150 °C for 24 h. Following that, DMF was used to filter and wash the precipitated white powder. In the next stage, the desiccator was applied to dry the powder at the room temperature. .[7]

The use of MOF-508a as a sensing component for the precise discerning of bisphenol A via the electrochemical technique, and its synthesis by a simple method are reported in the present study. Scanning electron microscopy (SEM) and x-ray diffraction (XRD) were applied to describe the MOF-508a's composition and structure. In addition, MOF-508a was employed so that the glassy carbon electrode could be altered for the electrochemical oxidation of bisphenol A. The results were indicative of illustration of obvious oxidation peak with lowering over-potential by the designed MOF-508a/GCE. In addition, there was a greater signal response compared to the unmodified electrode which was primarily attributed to the large active surface area provided by MOF-508a. As such, this process led to a considerable improvement in the electrochemical surface area. Moreover, adding the elevating bisphenol A concentration resulted in a severe elevation in the anodic peak, presented by the measurements of differential pulse voltammetry (DPV). Furthermore, excellent sensitivity (0.0564 μA/ μM-1) with a low limit of detection (0.03 μM), a wide linear range (0.1-700.0 μM), and a high selectivity were found for the analytical performance of the modified electrode.

Keywords: Bisphenol A, glass carbon electrode, Modified electrode

References

[1] B. Ntsendwana, B.B. Mamba, S. Sampath, O.A. Arotiba, Int. J. Electrochem. Sci. 7 (2012) 3501.
[2] N.B. Messaoud, M.E. Ghica, C. Dridi, M.B. Ali, C.M. Brett, Sens. Actuators B Chem. 253 (2017) 513.
[3] E.R. Santana, C.A. de Lima, J.V. Piovesan, A. Spinelli, Sens. Actuators B Chem. 240 (2017) 487.
[4]. E.R. Santana, C.A. de Lima, J.V. Piovesan, A. Spinelli, Sens. Actuators B Chem. 240 (2017) 487.
[5]. X. Cao, F. Shen, M. Zhang, J. Bie, X. Liu, Y. Luo, J. Guo, C. Sun, RSC Adv. 4 (2014) 16597.
[6]. F.A. Harraz, M. Faisal, A.A. Ismail, S.A. Al-Sayari, A.E. Al-Salami, A. Al-Hajry, M.S. Al-Assiri, J. Electroanal. Chem. 832 (2019) 225.
[7]. F.S. Shirazi, K. Akhbari, RSC Adv. 5 (2015) 50778.

Synthesis of nanoelectrode based on carbon paste for simultaneous voltammetric measurement of compounds of neurotransmitters

Peyman Mohammadzadeh Jahani[a]*, Maedeh Jafari[b]

[a]*Department of Medicine, Bam University of Medical Sciences, Bam, Iran*

[b]*Department of Pediatrics, School of Medicine, Kerman University of Medical Sciences, Kerman, Iran*

Email : mjpeyman@yahoo.com

Norepinephrine (NE) and Acetylcholine (ACh) are an important catecholamine neurotransmitter in the mammalian central nervous system[1,2].Recent reports have indicated that norepinephrine enhances[3,4].Acetylcholine (ACh) has been known as one kind of the most important neurotransmitters, which is involved in neurotransmission processes in both the peripheral and central nervous systemsadhesion of human immune deficiency virus1 (HIV-1)-infected leukocytes to cardiac micro vascularendothelial cells and also accelerates HIV replication via protein kinase. In this work, a highly effective voltammetric sensor fabricated for simultaneous analysis of norepinephrine and acetylcholine. The sensor was fabricated by the modification of carbon paste electrode with graphene quantum dots/ionic liquid (GQDs/IL/CPE). The electrochemical behavior of epinephrine on the modified electrode was studied using cyclic voltammetry (CV), differential pulse voltammetry (DPV) and chronoamperometry (CHA).The results indicate that the electrochemical responses are improved significantly with the use of the modified electrode. The calibration curve obtained by DPV, under the optimized conditions, showed linear range of 0.2–400.0 µM for norepinephrine (limit of detection 0.06 µM).The sensor was successfully used to detect the analytes in real samples..

Keywords: Norepinephrine, Acetylcholine, Modified electrode, neurotransmitters

References

[1]. A. C. Anithaa, K. Asokan, N. Lavanya, and C. Sekar, Biosens. Bioelectron., 143 (2019) 111598.

[2]. A. L. Liu, S. B. Zhang, W. Chen, X. H. Lin, and X. H. Xia, Biosens. Bioelectron., 23 (2008) 1488.

[3]. H. Beitollahi, H. Karimi-Maleh, and H. Khabazzadeh, Anal. Chem., 80 (2008) 9848.

[4]. H. Jeong, H. Kim, and S. Jeon, Microchem. J., 78 (2004) 181.

Designing and constructing an electrochemical sensor using a nanocomposite metal-organic framework and nitrogen-doped graphene oxide for the identification and measurement of Tartrazine

F. Sarkaboudi [a], Kh. Ghanbari[a]*, *M. Jelvehzadeh* [b]

**Department of Analytical Chemistry, Faculty of Chemistry, Alzahra University, P. O. Box 1993893973, Tehran, Iran*

**E-mail: Corresponding author E-mail: kh.ghanbari@alzahra.ac.ir*

Abstract Tartrazine (Tz) is a synthetic organic food dye that can be found in various food products like dairy products, beverages, candies, etc. The high concentrations of Tz can cause childhood asthma, allergies, anxiety, migraines, eczema, and dermal toxicity. Therefore, the detection of tartrazine content in food products is very important to improve food safety in the world. Until now, numerous analytical methods, such as HPLC, CE, and spectrophotometry have been reported for the determination of Tz. However, most of them need expensive equipment, large quantities of organic solvents, and pre-treatment involving extraction, separation, and adsorption with high costs and lengthy analysis time. On the other hand, electrochemical methods have attracted more attention due to their simplicity, fast response, high sensitivity and selectivity, and relatively low cost [1, 2]. In this research, a new electrochemical sensor was developed based on CPE/Cu-ZrMOF/NGO for the measurement of Tz. The morphology and structure of the nanocomposite (Cu-ZrMOF/NGO) were investigated using methods such as FE-SEM, EDS, Mapping, HR-TEM, IR, XRD, and XPS. CV, DPV, and EIS were used for electrochemical studies. The results indicated that the modification of the electrode surface increased its surface area and conductivity. The modified electrode showed a limited response of 0.25-100 µM and a detection limit of 0.06 µM (S/N=3) in the measurement of Tz. The designed sensor exhibited good features such as high sensitivity, selectivity, and repeatability. The obtained results in measuring tartrazine in real samples such as gelatin powder and pastilles were entirely satisfactory.

Keywords: Electrochemical sensor, Metal-Organic Frameworks, Nanocomposite, nitrogen doped graphene oxide, Tartrazine

References

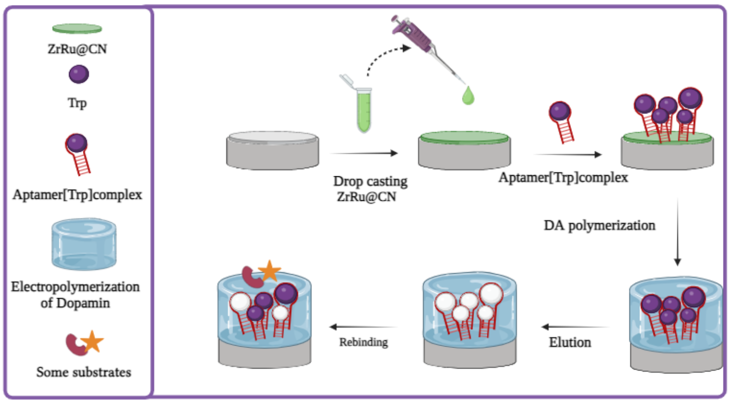
1. State, R.G., et al., *Rapid and sensitive electrochemical determination of tartrazine in commercial food samples using IL/AuTiO2/GO composite modified carbon paste electrode.* Food Chemistry, 2022. **385**: p. 132616.
2. Shume, W.M., et al., *Ni1Zn1-xLayFe2-yO4@ rGO nanocomposite as electrochemical sensor for simultaneous analysis of food colorants-sunset yellow and tartrazine.* Inorganic Chemistry Communications, 2023. **155**: p. 111071.

Dual recognition elements for selective determination of Tryptophan based on molecularly imprinted electrochemical aptasensor

Farzaneh Mohammadi*, Mahmoud Roushani

Department of Chemistry, University of Ilam, Ilam, Iran

Email: mohammadi.farzaneh89@yahoo.com



A major challenge in medical research is identifying biomarkers that can reveal diseases early [1]. Abnormal amino acid levels are linked to conditions like diabetes, renal failure, and various neurodegenerative diseases [2]. Tryptophan (Trp), an essential amino acid, cannot be produced by the body and must be obtained through diet [3]. The WHO advises a daily intake of 4 mg per kg of body weight for adults [4]. Trp deficiency can lead to fatigue, skin issues, and neurological disorders, while excessive intake may cause side effects like drowsiness and nausea. Abnormal metabolism of Trp can even induce severe psychological symptoms. Moreover, endogenous Trp is a potential biomarker for cancer monitoring. This work aims to create a simple, cost-effective method for accurately measuring Trp [5,6]. This study reports the development of a dual recognition biosensor for the selective detection of Trp. The biosensor was created by integrating aptamer strings and a molecularly imprinted polymer (MIP) onto a glassy carbon electrode (GCE) that was modified with heteroatom-doped metal-organic frameworks and doped carbon coating, tryptophan-specific thiol-aptamer, and electropolymerization of dopamine (ePDA). The ZrRu@CN/Aptamer/MIP system was characterized using cyclic voltammetry and electrochemical impedance spectroscopy. Due to the synergetic effect of MIP and aptamer towards Trp, compared with single-element sensors (aptamer or MIP), it showed a broad detection range, low detection limit, and higher selectivity for the Trp and facilitated detection in real samples.

Keywords: Molecularly imprinted polymer, Aptamer, Electropolymerization, Dual recognition elements, Tryptophan

REFERENCES:

[1] Y. Cheng, D.-Y. Tian, Y.-h. Wang, W. Liu, X.-L. Huo, N. Bao, Z.-Q. Wu, Analytica Chimica Acta, 1279 (2023) 341853.

[2] H. Khoshsafar, H. Bagheri, P. Hashemi, M.M. Bordbar, T. Madrakian, A. Afkhami, Talanta, 253 (2023) 124090.

[3] Ž.Z. Tasić, M.B.P. Mihajlović, M.B. Radovanović, A.T. Simonović, D.V. Medić, M.M. Antonijević, Scientific reports, 12 (2022) 5469.

[4] Y.-F. Zhong, G.-M. Bao, Y.-F. Xia, X.-X. Peng, J.-F. Peng, J.-X. He, S. Lin, L. Zeng, Q. Fan, W. Xiao, Analytica Chimica Acta, 1180 (2021) 338897.

[5] Y. Zhang, G.I. Waterhouse, Z.-p. Xiang, J. Che, C. Chen, W. Sun, Food chemistry, 326 (2020) 126976.

[6] I. Alam, B. Lertanantawong, T. Sutthibutpong, P. Punnakitikashem, P. Asanithi, Biosensors, 12 (2022) 291.

Formation of MOF-Chitosan-Nb composites to achieve advanced electrocatalytic activity for OER and HER

Maryam Mehrdadian[a], **Sadegh Khazalpour**[a*], **Ameneh Amani**[b]

[a]*Department of Chemistry, Faculty of Chemistry and Petroleum science, Bu-Ali Sina University, Hamedan, Iran*

[b]*Nahavand Higher Education Complex, Bu-Ali Sina University, Hamedan, Iran*

[*]*E-mail:* m.mehrdadian73@gmail.com

Abstract With the increasing use of fossil energy, environmental pollution and other problems are becoming more and more serious. Therefore, it's urgent to develop clean, efficient, and sustainable energy conversion and storage technologies [1]. Hydrogen and oxygen energy can be prepared in a variety of ways. Producing hydrogen and oxygen by water electrolysis has the advantages of a wide source of raw materials, which is considered to be one of the most likely methods to replace the fossil energy [7-8]. However, the electrolysis of water to produce H_2 and O_2 requires overcoming a high inherent potential. So, it's necessary to design and prepare a low-cost, efficient, and long-life dual-function electrocatalyst to reduce the over-potential of water electrolysis. MOF is a kind of nanoporous material with high specific surface area, variable pore structure, and structural diversity that has great application prospects in HER and OER [22,23].

For mentioned reason, in this study, MOF/Chitosan/Nb growing on NFF was prepared through a simple method. Electrochemical tests showed that the catalyst M-C-Nb@NF can perform OER and HER at current densities of 10 mA cm^{-2} only needing an overpotential of 100 mV and 160 mV, respectively. We think the MOFs growth on nickel–iron foam improves the conductivity and stability of the cell and using of niobium benefits exposing more active sites and enhances the synergistic interaction.

Keywords: Hydrogen evolution, Oxygen evolution, Electrochemistry water splitting, MOFs

References

[1] M. Wu, Y. Zhang, R. Zhang, J. Ma, N. Alonso-Vante, *Highly active oxygen evolution reaction electrocatalyst based on defective-CeO 2-x decorated MOF (Ni/Fe)*, 403 (2022) 139630–139637.

[2] Wang, Qiang, *FeNi-based bimetallic MIL-101 directly applicable as an efficient electrocatalyst for oxygen evolution reaction*, 286 (2019) 92-97.

[3] S. Song, L. Yu, X. Xiao, *Outstanding oxygen evolution reaction performance of NiFeSSe stainless-steel mat for water electrolysis*, 13 (2020) 100216–100241.

[4] C. Kim, S.H. Kim, S. Lee, I. Kwon, S. Kim, C. Seok, Y.S. Park, Y. Kim, *Boosting overall water splitting by incorporating sulfur into NiFe (oxy)hydroxide*, 64 (2022) 364–371.

[5] Z. Wang, J. Xu, J. Yang, Y. Xue, L. Dai, *Ultraviolet/ozone treatment for boosting OER activity of MOF nanoneedle arrays*, 427 (2022) 131498–131507.

Fabrication of electrochemical biosensors based on aptamer and doped magnetic nanoparticles on silica coated nanotubes for breast cancer detection

Elnaz Riahipour, Masoud Rohani Moghadam*, Alireza Bazmandegan Shamili, Zahra Shekari, Masoud Rezaei Nasab

Department of Chemistry, Faculty of Science, University Vali-e-Asr, Rafsanjan, Iran

*E-mail: *elnazriahipour@gmail.com*

Abstract

Background: Cancer is the second leading cause of death in the world after cardiovascular diseases [1]. Globally, breast cancer (BC) is the most prevalent type of cancer in women which caused (626,679) 6.6% of cancer deaths in 2018. Early diagnosis is the key to better prognosis of BC and it can be achieved by assessment of biomolecules which are known as biomarkers. The assessment of biomarkers at early stage can predict the cancer occurrence probability at preclinical phase and helps to manage in delaying of disease/prognosis along with future therapy prediction [2]. Aptamers are single-stranded DNA or RNA oligonucleotides and They are promising in producing more sensitive and reliable biosensor substrates in combination with a wide range of nanomaterials [3].

Results: This study aims at designing a novel impedimetric aptasensor to determine antigen CEA_125. The CEA_125 aptasensor was developed by covalent immobilization of an CEA_125 aptamer on the surface of a glassy carbon electrode (GCE) which was modified by Doping of Magnetic Nanoparticles on Silica-Covered Carbon Nanotube. After the aptamer was immobilized, CEA_125 was incubated on the surface of an Ap-Fe_3O_4/Sio_2/MWCNT-GCE. Through the EIS method, the linear range and the detection limit of CEA_125 were found to be $1.0 \times 10^{-3}-100.0$ ng mL^{-1}and 9.8×10^{-4} ng mL^{-1} respectively.

Significance: The proposed aptasensor was used to determine of CEA_125 in patient and healthy human serum samples and the results indicated that this aptasensor has great potential for practical application which the strength point of this aptasensor.

Keywords: Aptamer, CEA-125 cancer antigen, Silica, Carbon nanotubes, Magnetic nanoparticles

References

[1] Akulapalli Sudhakar, *cancer science & therapy* 1.2 (2009): 1.

[2] Ranjan.P, Parihar.A, Jain.S, Kumar. N, Dhand.C, Murali, S & Khan, *Analytical biochemistry* 610 (2020): 113996.

[3] Liu. M, Yu. X, Chen.Z, Yang. T, Yang. D, Liu, Q & He, N, *nanobiotechnology* 15 (2017): 1-16.

Voltammetric determination of glucose at the surface of carbon paste electrode modified with nickel complex from tridentate Schiff base ligand and graphene oxide nanoparticles

Hasan karami, Masoud Rohani Moghadam*, Masoud Rezaeinasab, Samira Saeednia, Elnaz Riahipour

Department of Chemistry, Faculty of Science, University Vali-e-Asr, Rafsanjan, Iran

**E-mail: elnazriahipour@gmail.com*

Abstract

Background: Glucose is the main constituent of some energetic biopolymers, such as cellulose, starch and glycogen. In addition, glucose is a metabolite material in living organisms, especially in the case of diabetic patients. Nowadays, extra than 220 million of people are suffering from diabetes (this disease is known as an abundant metabolic disorder). So, the detection of glucose in the patient’s blood is very important for control of diabetes disease [1]. Besides that, the determination of glucose in food industry is necessary and it is routinely performed in juice, honey, and milk samples [2]. Therefore, it is so significant to develop some methods with high sensitivity, selectivity and stability to determine the levels of glucose in real samples [3].

Results: The electrochemical sensors are the most favorite methods for glucose determination compared with traditional methods according to their simplicity, sensitivity, portability, provide continuous real-time detection and not expensive. So that, in this work, a sensitive voltammetric sensor based on a carbon paste electrode modified with graphene oxide nanoparticle and nickel complex from tridentate Schiff base ligand as a modifier was designed for determination of glucose. According to the obtained results from cyclic voltammetry, there is no oxidation peak for glucose at unmodified carbon paste electrode. The modified electrode with modifier and graphene oxide nanoparticle was shown the oxidation peak for glucose at 0.35V. Also differential pulse voltammograms for the designed sensor demonstrated wide linear range from 0.50 to 90.00 µM and low detection limit of 0.16 µM for glucose.

Significance: This sensor was used for determination of glucose in blood serum solutions. the obtained reasults reveale that the designed sensor is capable in real sample.

Keywords: Glucose, Modifier, Carbon paste electrode, Sensor

References

[1] P. Moozarm Nia, W. Meng, F. Lorestani, M.R. Mahmoudian, Y. Alias, *Sensors and Actuators B*, 209 (*2015*), 100.
[2] V. Rajendran, J. Irudayaraj, *Journal of Dairy Science*, 85 (2002) 1357.
[3] F.H. Meng, W. Shi, Y.N. Sun, X. Zhu, G.S. Wu, C.Q. Ruan, et al., *Biosensors and Bioelectronics*,42 (2013) , 141.

مروری کوتاه بر روی سنتز نانوکاتالیست اکسید دو فلزی و نقاط کوانتومی گرافنی و کاربرد آن در اکسایش متانول

Masoumeh Madadi[a], Masoud Rohani Moghadam[b], Parisa Salarizadeh[c]

[a]*Department of Chemistry, Faculty of Basic Sciences, Vali-e-Asr University Rafsanjan, Rafsanjan, Iran*

[b]*Department of Chemistry, Faculty of Basic Sciences, Vali-e-Asr University Rafsanjan, Rafsanjan, Iran*

[c]*Department of Fuel Cell, Faculty of Basic Sciences, Vali-e-Asr University Rafsanjan, Rafsanjan, Iran*

**E-mail: M_MADADI8@YAHOO.COM*

**E-mail: m.rohani@vru.ac.ir*

**E-mail: P.Salarizadeh@vru.ac.ir*

چکیده:

پیل‌های سوختی فناوری جدیدی برای تولید انرژی هستند که مستقیماً سوخت و اکسیدکننده را برای تولید انرژی الکتریکی با راندمان بالا و بدون ایجاد آلودگی محیطی یا صوتی ترکیب می‌کند. این پیل‌های سوختی که می‌توانند مستقیماً با سوخت‌هایی مانند متانول (معروف به پیل‌های سوختی متانول مستقیم) کار کنند، مزایایی مانند وزن کم، حداقل آلودگی، دمای عملیاتی پایین و اندازه جمع و جور در مقایسه با سایر منابع انرژی دارند که این ویژگی‌ها آنها را برای ذخیره سازی و حمل و نقل مفید می‌کند. در این پژوهش اکسید دو فلزی $CoCu_2O_4$ و نانوکامپوزیت فلزی $CoCu_2O_4/GQDs$ طراحی و به روش هیدروترمال سنتز شدند. از الکتروکاتالیست‌های ساخته شده در این بخش برای بهبود سطح الکترود خمیر کربن استفاده گردید. نانوکامپوزیت حاصل توسط طیف سنجی‌های مادون قرمزتبدیل فوریه (FT-IR)، EDS، XRD و TEM شناسایی شدند. نانوکامپوزیت حاصل عملکرد الکتروکاتالیستی خوبی را برای تجزیه مولکول‌های متانول در محیط قلیایی ارائه داد. این مشاهدات به دلیل اثرات هم افزایی و وجود پشتیبانی GQDs (رسانایی بالا) بوده است. این آزمایش نشان می‌دهد که افزایش چگالی جریان $CoCu_2O_4/GQDs$ (56.5 mA cm-2) درمقایسه با CoCu2O4 (40.67 mA cm-2) قابل مشاهده است که فعالیت الکتروشیمیایی بالای آنها را به واسطه حضور نقاط کوانتومی گرافن تایید می‌کند.

نتیجه‌گیری:

نانوذرات GQD ترکیب شده با $CoCu_2O_4$ منجر به افزایش سطح ویژه لایه‌های ایجاد شده می‌شود. در این لایه‌ها توزیع نانوذرات نسبتاً یکنواخت می‌باشد و با اینکه مورفولوژی سطح کاملا تغییر پیدا کرده است، با این‌حال نانوذرات $CoCu_2O_4$ را بر روی لایه‌های نقاط کوانتومی گرافن می‌توان دید. در این شکل چگالی بالا و حفرات واضح قابل مشاهده است. نانوکامپوزیت سنتز شده کروی شکل هستند که ذرات کمتر از ۱۰ نانومتر با استفاده از TEM نشان می‌دهد. علاوه بر این، مقادیر R_{CT} اندازه‌گیری‌شده برای نانوکامپوزیت‌های $CuCo_2O_4/GQD$ (R_{CT} = 135 Ω) و $CoCu_2O_4/GQDs$ (R_{CT} = 233 Ω) در مقایسه با $CuCo_2O_4$ (R_{CT} = 144 Ω) و $CoCu_2O_4$ ($R_{CT=}$ = 1.02kΩ) کمتر بوده که نشان می‌دهد سینتیک انتقال بار اکسید دو فلزی $CuCo_2O_4$ و نانوکامپوزیت حاصل آن بیشتر است.

کلمات کلیدی: اکسیدهای فلزات واسطه دوتایی، نانوکامپوزیت، نقاط کوانتومی گرافن، اکسایش متانول

References

[1] Xiao, X., Zhang, Z., Nan, F., Zhao, Y., Wang, P., He, F., & Wang, Y. (2021). Mesoporous CuCo2O4 rods modified glassy carbon electrode as a novel non-enzymatic amperometric electrochemical sensors with high-sensitive ascorbic acid recognition. Journal of Alloys and Compounds, 852, 157045.

[2] Pandey, R. R., & Chusuei, C. C. (2021). Carbon nanotubes, graphene, and carbon dots as electrochemical biosensing composites. Molecules, 26(21), 6674.

[3] un L, Li H, Li M, Li C, Li P, Yang B (2016) Simultaneous determination of ascorbic acid, dopamine, uric acid, tryptophan, and nitrite on a novel carbon electrode. J Electroanal Chem 783:167– 175.

An ultrasensitive sandwich-type electrochemical immunosensor for the determination of prostate specific antigen (PSA) using Ti_3C_2 MXene @CuAu-LDH labeled Ti_3C_2@AuNPs as a signal tag

Mohammad Safarpoor [a*], Rassoul Dinarvand[a], Mehrorang Ghaedi [b], Arash Asfaram [c]

[a] *Nanotechnology Research Center, Faculty of Pharmacy, Tehran University of Medical Sciences, Tehran, Iran*
[b] *Department of Chemistry, Yasouj University, Yasouj, Iran*
[c] *Medicinal Plants Research Center, Yasuj University of Medical Sciences, Yasuj, Iran*
[*]*E-mail: safarpoormohamad@yahoo.com*

Abstract

Background:

Prostate cancer ranks among the most prevalent malignant tumors in men globally [1]. The monitoring of PSA[1] levels is crucial for the early detection of prostate cancer, aiming to lower the death rate and enhance the quality of life for patients [2]. Therefore, there is a pressing need to create a straightforward method or device that can deliver cost-effective and dependable results for cancer patients. One of the main challenges in making in immunosensor for the determination of PSA is, the complex nature of biological samples can lead to non-specific binding of molecules to the sensor surface, which may result in false positive or inaccurate results. This can affect the reliability and accuracy of the PSA detection. Another issue is the stability and reproducibility of the signal tag.

Results:

we have developed an electrochemical immunosensor for the detection of prostate-specific antigen. The modified GCE was characterized using SEM, EDX, CV and EIS. Immunosensing in phosphate buffer pH 7.0 by DPV. Under optimized conditions steady state current increased linearly with PSA concentration over the range 0.02-2 pg/ml with a detection limit of 1.5 fg/ml. The calibration equation is $y(\mu A)= 14.113\ x\ (pg\ mL^{-1})+3.6959\ pg\ mL^{-1}$.

Significance:

Owing to some advantages such as selectivity, stability, repeatability and reproducibility, this developed immunosensor provides clinical applications for better life quality. In e amount of solvent comsumed was low, environmental pollution effect of electrochemical immunosensor was minimized and it is used instead of expensive systems such as HPLC, GC, MS.

Keywords: Electrochemical immunosensor, Prostate specific antigen (PSA), Ti_3C_2 MXene @CuAu-LDH

References

[1] M.M. Center, A. Jemal, J. Lortet-Tieulent, E. Ward, J. Ferlay, O. Brawley, F. Bray, International variation in prostate cancer incidence and mortality rates, *Eur. Urol.* 61 (2012) 1079–1092.
[2] M.R. Cooperberg, J.D. Brooks, A.V. Faino, L.F. Newcomb, J.T. Kearns, P.R. Carroll, A. Dash, R. Etzioni, M.D. Fabrizio, M.E. Gleave, T.M. Morgan, P.S. Nelson, I. M. Thompson, A.A. Wagner, D.W. Lin, Y. Zheng, Refined analysis of prostate specific antigen kinetics to predict prostate cancer active surveillance outcomes, *Eur. Urol*. 74 (2018) 211–217.

---

[1] *Prostate Specific Antigen*

Electrochemical behavior of carbon quantum dots- based composite coatings on 316L stainless steel in chloride environments

Meysam Gharehdaghi, Hamid R. Zare, Zahra Mohammadpour, Sara Dehghan-Chenar

Department of Chemistry, Yazd University, Yazd, 89195-741, Iran

meysam_ir@yahoo.com

316L stainless steel has attracted attention in various industries, particularly the marine industry [1], due to its unique characteristics. However, its susceptibility to pitting corrosion in chlorine-containing environments can lead to significant damage [2]. As a result, controlling corrosion has become a crucial practical issue [3]. One effective method of reducing corrosion rates is the use of protective coatings [4]. This study focuses on the investigation of a composite coating that encapsulates carbon quantum dots (CQDs) within metal-organic frameworks doped with polyvinyl alcohol polymer. The characteristics of the coating were analyzed using various techniques including SEM, TEM, FTIR spectroscopy, and XRD patterns. Furthermore, the corrosion parameters of the coating were evaluated through potentiodynamic polarization plots and electrochemical impedance spectroscopy (EIS) in a 3.5% NaCl corrosive environment at 25°C. The obtained results indicate that the composite coating with CQDs demonstrates the highest inhibition percentage compared to the composite coating without CQDs. The composite coating with CQDs exhibited an inhibition efficiency of 83% after 24 hours of immersion in a 3.5% NaCl corrosive medium. This suggests that incorporating CQDs into the metal-organic frameworks creates a protective film that effectively prevents direct contact between the metal surface and its surrounding environment. Additionally, the composite coating with CQDs showcases a lower corrosion current density compared to the composite coating without CQDs, highlighting its optimal performance in reducing corrosion rates.

Keywords: Anti-corrosion coating, Corrosion, Carbon quantum dots, Metal–organic framework

References

[1] T. Voisin, R. Shi, Y. Zhu, Z. Qi, M. Wu, S. Sen-Britain, Y. Zhang, S. Qiu, Y. Wang, S. Thomas, *Jom*, 74 (2022) 1668-1689.
[2] M.P. Ryan, D.E. Williams, R.J. Chater, B.M. Hutton, D.S. McPhail, *Nature*, 415 (2002) 770-774.
[3] S. Sen-Britain, S. Cho, S. Kang, Z. Qi, S. Khairallah, D. Rosas, V. Som, T.T. Li, S. Roger Qiu, Y. Morris Wang, *Nature Communications*, 15 (2024) 867.
[4] J.-M. Zen, A. Senthil Kumar, D.M. Tsai, *Electroanalysis*, 15 (2003) 1073-1087.

A non-enzymatic electrochemical glucose sensor based on Co_3O_4/rGO nanocomposite and chitosan-based molecularly imprinted polymer

Mahshid Padash[a,b], Mehdi Mousavi[a, *] , Abbas Ali Mohammadi[a,b]

[a]*Department of Chemistry, Shahid Bahonar University of Kerman, Kerman, Iran*

[b]*Young Researchers Society, Shahid Bahonar University of Kerman, Kerman, Iran*

[*]*E-mail:* mmousavi@uk.ac.ir

mohammadi.abbas7778@gmail.com

Glucose is a simple sugar essential for human metabolism. Monitoring glucose levels is crucial for diagnosing and managing various health conditions, including diabetes, hypoglycemia, and hyperglycemia. Traditional methods for glucose determination often involve enzymatic techniques, which can be expensive, susceptible to interference, and require complex procedures [1]. Electrochemical methods offer a promising alternative due to their inherent advantages, such as rapid response, low cost, and potential for miniaturization [2-4]. However, developing accurate and sensitive electrochemical sensors for glucose remains a significant challenge, particularly in real-world biological samples. Therefore, the primary objective of this research is to design an electrochemical sensor capable of reliably and accurately determining glucose concentrations in biological fluids. A novel non-enzymatic electrochemical sensor for glucose detection has been developed. This sensor utilizes a cobalt oxide/reduced graphene oxide nanocomposite (Co_3O_4/rGO) and a chitosan molecularly imprinted polymer (MIP) to enhance sensitivity and selectivity, respectively. The Co_3O_4/rGO nanocomposite improves electron transfer. MIP polymer film was deposited on the electrode surface using chronoamperometry. The sensor exhibited a linear response range of 50-1000 nM with a low detection limit of 13.07 nM. The sensor's reproducibility was good, with inter-day and intra-day variations of 2.05% and 3.64%, respectively. Real-sample analysis demonstrated the sensor's practical applicability. In urine samples, the sensor achieved a recovery rate of 90.52%. Additionally, blood serum sample determinations correlated well with standard methods in clinical laboratory, indicating high accuracy (percent relative error = 9.8%). The sensor's ability to detect low glucose concentrations with high precision makes it well-suited for medical diagnostics.

Keywords: Glucose, Co3O4/rGO, Electrochemical sensor, Molecularly imprinted polymer (MIP)

References

[1] Qian, Wenhao, Tao Song, Mao Ye, Xiaoyu Huang, Yongjun Li, and Bingjie Hao. *Journal of Materials Science & Technology* 122 (2022): 141-147.

[2] Li, Yong-Yu, Ping Kang, Hong-Qi Huang, Zhong-Gang Liu, Gang Li, Zheng Guo, and Xing-Jiu Huang. *Sensors and Actuators B: Chemical* 307 (2020): 127639.

[3] Xu, Zhihao, Qinzhi Wang, Hui Zhangsun, Shuang Zhao, Yijian Zhao, and Li Wang. *Food Chemistry* 349 (2021): 129202.

[4] Maghsoudi, Shahab, and Arman Mohammadi. *Synthetic Metals* 269 (2020): 116543.

Voltammetric determination of metformin in aqueous solution by Cu(OH)$_2$-Ag-MWCNTs nanocomposite modified electrode

Shokooh Bahrami*, Abdollah Yari

Faculty of Chemistry, Lorestan University 68137-17133.Khorramabad-Iran

* *shokoohbahrami@yahoo.com*

Abstract:

In this work, under optimal conditions, a glassy carbon electrode modified with Cu(OH)2-Ag-MWCNTs nanocomposite was used to measure metformin (MET) in blood serum samples and metformin tablets by voltammetric method. Fourier-transform infrared spectroscopy (FTIR) Scanning electron microscopy (SEM), Energy Dispersive X-ray Spectroscopy (EDX) and X-ray diffraction (XRD) methods were used to check the electrode surface. All electrochemical measurements were carried out in solution with pH equal to 12 by cyclic voltammetry and differential pulse voltammetry. The response of the sensor in the range of 0.1 to 50 μM was obtained linearly with a limit of detection (LOD) of 0.04 μM. This sensor was used to determine MET in real samples and obtained acceptable results.

Keywords: metformin; silver; voltammetry; MWCNTs; modified electrode

References

[1] R.A. DeFronzo,1992. Pathogenesis of type 2 (non-insulin dependent) diabetes mellitus: a balanced overview. *Diabetologia*, *35*(4), pp.389-397.

[2] E. Uçaktürk, 2013. The development and validation of a gas chromatography-mass spectrometry method for the determination of metformin in human plasma. *Analytical Methods*, *5*(18), pp.4723-4730.

[3] H. Amini, A. Ahmadiani and P. Gazerani, 2005. Determination of metformin in human plasma by high-performance liquid chromatography. *Journal of Chromatography B*, *824*(1-2), pp.319-322.

[4] A.E.O. Valdivia, C. Montaño-Osorio, and Y.M. Vargas-Rodríguez, 2019. Conductometric titration of metformin hydrochloride: simulation and experimentation. *J. Chem*, *13*, pp.105-111.

[5] H. Beitollahi, F. Movahedifar, S. Tajik and S. Jahani, 2019. A review on the effects of introducing CNTs in the modification process of electrochemical sensors. *Electroanalysis*, *31*(7), pp.1195-1203.

[6] O.E. Fayemi, A.S. Adekunle and E.E. Ebenso, 2017. Electrochemical determination of serotonin in urine samples based on metal oxide nanoparticles/MWCNT on modified glassy carbon electrode. *Sensing and Bio-Sensing Research*, *13*, pp.17-27.

Investigating the corrosion behavior of copper metal with graphene oxide/zinc rich epoxy coating in 3.5% NaCl solution

Fatemeh Shirvani, **Hamid Reza Zare**, **Zahra Akhavan**

Department of Chemistry, Yazd University, Yazd, 89195-741, Iran

E-mail: fatemeh.shirvani98@gmail.com

Abstract

Corrosion is a significant issue in various industries, causing substantial damages annually. To address this problem, extensive research is needed to develop effective corrosion prevention methods [1, 2]. In this study, we investigated the corrosion behavior of copper metal in a corrosive 3.5 wt% NaCl solution using two types of anti-corrosion coatings: zinc-enriched epoxy coating (ZRE) and an epoxy composite rich in graphene oxide and zinc (GO-ZRE). The investigation was conducted at different temperatures (15, 25, 35, and 45 °C). The performance of the coatings was evaluated based on electrochemical data obtained from open circuit potential (OCP) plots, polarization (Tafel) plots, and electrochemical impedance spectroscopy (EIS) plots. The Tafel results revealed that the corrosion rate decreases when the copper surface is coated with ZRE. At 45°C, the ZRE coating exhibited an inhibition efficiency of 15.15%. On the other hand, the deposition of the GO-ZRE composite coating on the copper surface significantly increased the inhibition efficiency to 88.89% at 45°C. This improvement can be attributed to the better filling of surface pores, resulting in reduced contact between the corrosive NaCl solution and the metal surface [3, 4]. All three evaluation methods consistently demonstrated that the GO-ZRE composite coating offers greater resistance compared to the ZRE coating. These findings indicate that the GO-ZRE composite can be used to develop corrosion-resistant coatings for various substrates in a 3.5 wt% NaCl environment.

Keywords: Corrosion, Anti-corrosion coatings, Zinc-rich epoxy, Graphene oxide

References

[1] S. Ahmad, I.A. Channa, Journal of Modern Science and Technology, 1 (2013) 1-18.
[2] J. Yang, S. Gunasekaran, Carbon Balance and Management, 51 (2013) 36-44.
[3] S. Wang, J. Yang, J. Cao, L. Gao, C. Yan, International Journal of Electrochemical Science, 14 (2019) 9671-9681.
[4] D. Xie, J. Hu, S. Tong, J. Wang, J. Zhang, Acta Metallurgica Sinica - Chinese Edition, 40 (2004) 103-108.

Investigation of the electrochemical behavior of dopamine in aqueous solution

Narges Mehrpour, Hamid R. Zare, Mansour Namazian

Department of Chemistry, Yazd University, Yazd, 89195-741, Iran

E-mail: narges.1375.mehrpour@gmail.com

Abstract

Dopamine is an organic compound of the catecholamine family. Disruption in the secretion of dopamine can lead to the neurological diseases of schizophrenia, depression, psychosis, autism and Parkinson's in humans [1-3]. Therefore, measuring the amount of dopamine and investigating its electrochemical behavior in different environments can help to diagnose and treat various diseases. Despite the fact that extensive research has been performed in the field of measuring dopamine using various spectroscopic and electrochemical methods, less research has been done in the direction of the electrochemical behavior of this compound [4,5]. In this research, the electrochemical behavior of dopamine as an important biological compound in the aqueous solution has been investigated. Cyclic voltammetry method has been used to understand the electrochemical behavior of dopamine. In order to find out the electrochemical mechanism of dopamine, the effect of factors such as solution pH, dopamine concentration, and potential scan rate on its voltammetric responses has been investigated. The resulting data indicate that the electrochemical behavior of dopamine follows an ECE mechanism. Also, some thermodynamic parameters related to dopamine oxidation process were obtained experimentally and using theoretical models. For example, the pK_a value of dopamine was found to be 8.5 based on experimental data and 8.9 based on theoretical models. The comparison of theoretical and experimental data indicates the agreement between the results of both methods and therefore the confirmation of the theoretical models. This investigate gives us the confidence that using theoretical models can make correct predictions about the electrochemical behavior of electroactive compounds.

Keywords: Dopamine, Cyclic voltammetry, Thermodynamic parameters, Electrochemical behaviour

References

[1] Kasturi, P. R.; Aparna, T. K.; Arokiyanathan, A. L.; Lakshmipathi, S.; Sivasubramanian, R.; Lee, Y. S.; Selvan, R. K. *Materials Chemistry and Physics* 2021, *260*, 124094.
[2] Mirzahosseini, A.; Pálla, T.; Orgován, G.; Tóth, G.; Noszál, B. *Journal of Pharmaceutical and Biomedical Analysis* 2018, *158*, 346.
[3] Shahparast, S.; Asadpour-Zeynali, K. *Electrochemistry Communication* 2024, *165*, 107756.
[4] Li, J.; Li, Q. *Materials Science and Engineering C* 2013, *33*, 507.
[5] Winter, E.; Codognoto, L.; Rath, S. *Electrochimica Acta* 2006, *51*, 1282.

performance supercapacitor

Maryam Sadat Miresmaeili, Fatemeh Khoramjah, Nourali Mohammadi*
Iranian Research & Development Center for Chemical Industries (IRDCI), Academic Center for Education, Culture andResearch (ACECR), Karaj, Iran

E-mail: nourali.mohammadi1@gmail.com

Abstract

mesoporous carbon (MC) was successfully synthesized via a facile hard templating pathway. The obtained material exhibited an interconnected porous framework with a high specific surface area of 1350 m2 g−1, average pore diameter of 5.5 nm and pore volume of 3.12 cm3 g−1. In addition, the possibility of Potassium ferrocyanide ([K3Fe(CN)6] as efficient redox mediator was investigated using different techniques. The supercapacitor performance of MC electrode was significantly enhanced through introducing of 0.1M Potassium ferrocyanide into 1 M aqueous solution of Na2SO4. Analysis of scan rate by Trasatti method indicated that 86.5% of the overall capacitance was originated through the insertion of Reactive Potassium ferrocyanide. The presented supercapacitor system exhibited a high specific capacitance of 539 F g−1, a good rate capability of 291.42 F g−1 at 10 A g−1 with 54% capacitance retention. Moreover, reasonable cycle durability with about 73% retention after a prolonged successive cycling process (2000 cycles) at current density of 2 A g−1 was obtained. Finally, the specific energy of 9.8 W h kg−1 at specific power of 254 W kg −1 was achieved for symmetric device which shows 2.3 times increase in specific Energy over the MC electrode with pure Na2SO4 electrolyte.

Keywords: Redox additive, Supercapacitor, Mesoporous Carbon

References

[1]S Li, Z. Zhao, B. Li, T. Wei, H. Jiang, Z.Yan, International Journal of Hydrogen Energy, 47 (2022) 10689.

[2] E. Azwar, W. Mahari, JH.Chuah, DN. Vo, NL. Ma, WH. Lam, et al, , International Journal of Hydrogen Energy, 43 (2018) 20811.

Implementation of the electrochemical and hydrothermal approaches to synthesis of cobalt oxide nanostructure for supercapacitor applications

Sayed Habib Kazemi[a, *], **Esmaeel Sanjeri**[a] , **Yosra Kavarizadeh**[a]

[a] *Department of Chemistry, Institute for Advanced Studies in Basic Sciences (IASBS), Zanjan 45137-66731, Iran.*

[*] *E-mail: habibkazemi@iasbs.ac.ir*

Supercapacitors have attracted tremendous interest as an alternative energy storage device because of their remarkable power density and longer cycle life, besides to considerable energy density. The performance of supercapacitors is mainly originated from the properties and structure of the electrode materials. Amongst all the electrode materials, metal oxides are playing vital role to fabricate supercapacitor electrodes. This work reports the effectiveness of the application of both electrochemical and hydrothermal methods to fabricate novel electrode materials for supercapacitors. Herein, in continuation of our previous works in our research group, cobalt oxide was deposited on the substrate using the combined electrochemical and hydrothermal methods as a novel method for synthesis of nanostructures. The morphology and spectroscopic studies of the nanomaterials were carried out using scanning electron microscopy, FT-IR spectroscopy, X-ray diffraction, and thermal analysis. Additionally, the electrochemical behaviors of synthesized electrode were examined by cyclic voltammetry, galvanostatic charge/discharge and ac impedance spectroscopy. A maximum specific capacitance of almost 1,200 F g^{-1} (at 5 mV s^{-1}) was achieved for Co_3O_4/NF electrode, in addition to an excellent cycling stability of approximately 120% (capacitance retention) over 10,000 cycles. Our findings suggest the combined synthesis approaches can be considered as an effective strategy to produce novel supercapacitor electrode materials.

Keywords: Nanostructure, Hydrothermal, Supercapacitor, cobalt oxide

References

[1] McCloskey, B.D., *The journal of physical chemistry letters*; (2015): 3592-3593.

[2] Zhou, L, et al., *Metal Oxides in Energy Technologies*; (2018): 169-203.

[3] Yang, L., et al., *Nano letters* 12.1 (2012): 321-325.

Enhanced electrochemical and mechanical properties of Collagen-based hybrid hydrogels incorporating Graphene Oxide, Silica and Carbon Nanotubes for biomedical applications

Shima Shabani, Javad Safaei-Ghomi*, Hossein Mojtabazadeh

Faculty of Chemistry, University of Kashan, Kashan, I. R. Iran

**E-mail: safaei@kashanu.ac.ir*

Abstract

The development of electroconductive hydrogels with enhanced mechanical, electrical, and biocompatibility characteristics is crucial for advancing electrochemical biosensors and bioelectronic applications [1]. Collagen, a biopolymer renowned for its exceptional biocompatibility, often lacks sufficient mechanical strength for sophisticated applications, necessitating the incorporation of reinforcing agents [2]. In this study, graphene oxide (GO), noted for its superior electrical conductivity, and silica nanoparticles (SiO_2), known for augmenting mechanical strength and thermal stability, were integrated into a collagen matrix. To further enhance the properties, carbon nanotubes (CNTs), with their remarkable electrical conductivity and mechanical resilience, were also incorporated, resulting in a novel hybrid hydrogel with amplified electrochemical and mechanical properties.

The synthesized hydrogels, incorporating varying concentrations of GO, SiO_2 and CNTs, demonstrated significant improvements. Specifically, 3 wt% GO markedly increased electrical conductivity, while CNTs further enhanced both the conductivity and mechanical robustness. Electrochemical impedance spectroscopy (EIS) validated the enhanced conductive properties, and cyclic voltammetry (CV) confirmed the stable redox behaviour of the hydrogel. These findings underscore the material's suitability for electroactive tissue engineering and controlled drug delivery systems.

Biocompatibility assays revealed minimal cytotoxicity, affirming the hydrogel's potential for in vivo electrochemical biosensing and biomedical device applications. This study highlights the synergistic benefits of combining collagen with GO, SiO_2 and CNTs, addressing the limitations of traditional hydrogels and advancing the design of electrochemical biomaterials with superior performance.

Keywords: Electroconductive Hydrogel, Biocompatibility, Silica Nanoparticles, Graphene Oxide, Collagen

References

[1] Shi, Zhijun, Xing Gao, Muhammad Wajid Ullah, Sixiang Li, Qun Wang, and Guang Yang. "Electroconductive natural polymer-based hydrogels." Biomaterials 111 (2016): 40-54.

[2] Kumar, A., R. K. Mishra, K. Verma, S. M. Aldosari, C. K. Maity, S. Verma, R. Patel, and V. K. Thakur. "A comprehensive review of various biopolymer composites and their applications: from biocompatibility to self-healing." Materials Today Sustainability 23 (2023): 100431.

Improved electrocatalytic degradation of SARS-CoV drug favipiravir by a highly porous 3D carbon felt/ β-PbO_2 electrode

Parva Ashrafi[a], Amin Ansari[a*], Davood Nematollahi[a,b]*

[a]*Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran*
[b]*Planet Chemistry Research Center, Bu-Ali Sina University, Hamedan, Iran*
[*]*E-mail:* parva.ashrafi67@gmail.com

Abstract: Favipiravir (FAV) is a widely used antiviral drug effective against various viruses, including SARS-CoV-2 and influenza. Its environmental persistence poses a significant concern, as it exhibits resistance to biological and photodegradation. This study investigates the electrocatalytic degradation of FAV using a three-dimensional porous carbon felt/β-PbO2 anode. The characteristics of the prepared anode were analyzed using SEM, EDX, Mapping and XRD.

Background:

- The COVID-19 pandemic, declared by the World Health Organization on March 11, 2020, significantly increased the prescription and consumption of antiviral drugs [1]. Many of these drugs, including FAV, are not completely metabolized in the human body, leading to their presence in wastewater either in their original form or as metabolites [2,3].

Results:

- Given the environmental implications, there is an urgent need for effective methods to degrade FAV in wastewater before its discharge into water sources. Traditional wastewater treatment techniques, such as biological treatment, chemical coagulation, and advanced oxidation, often suffer from limitations like low efficiency, high costs, and the generation of toxic intermediates [4,5].

Significance:

- This research focuses on the electrocatalytic degradation of FAV using the CF/β-PbO2 anode. At a current density of 4 mA cm^{-2} over 120 minutes, the anode achieved a remarkable FAV degradation efficiency of 90.2%. This modified anode demonstrates significant advantages, including long operational life and excellent electrocatalytic performance, making it a promising candidate for future studies on the degradation of persistent organic pollutants in wastewater.

Keywords: Favipiravir; SARS-CoV-2, Electrocatalytic Degradation.

References

[1] T. Singhal, *The indian journal of pediatrics*, 87 (2020) 281.
[2] V. Pilkington, P. Toby, H. Andrew, *Journal of virus eradication*, 6 (2020) 45.
[3] J. Radjenovic, S. David, L, *Environmental science & technology*, 49 (2015) 11292.
[4] P. Ashrafi, D. Nematollahi, A. Shabanloo, A. Ansari, M. Eslamipanah, B. Jaleh, *Electrochimica Acta*, 458, (2023) 142555.
[5] S. Huang, Y. Lei, P. Guo, H. Chen, S. Gan, *Chemical Engineering Journal*, 484 (2024) 149543.

Electrochemical reduction of CO_2 at the surface of reduced graphene oxide/silver nanocomposite

Hamed Negahbanfard*, Hamid R. Zare, Hossain Khoshro

Department of Chemistry, Yazd University, Yazd, 89195-741, Iran

*E-mail: Hamed.ng@hotmail.com

Abstract

Carbon dioxide is the main greenhouse gas and a C1 feedstock. Consequently, the conversion of CO_2 into useful compounds is considered a crucial technology [1]. Among the various methods, one effective approach is the electrochemical reduction reaction of CO_2, which enables its conversion into other compounds [2-4]. However, a major challenge faced in this process is the high overvoltage that occurs when reducing CO_2 on common electrode surfaces. To address this issue, a composite material consisting of silver nanoparticles and reduced graphene oxide (Ag/rGO) was employed in this study to decrease the overvoltage during the electrochemical reduction of CO_2 in an aqueous medium. The efficiency of this nanocomposite in reducing the CO_2 overvoltage was evaluated using cyclic voltammetry. The results showed a significant reduction of approximately 400 mV in the overvoltage of CO_2 reduction at a current density of 1 mA/cm^2. Furthermore, the diffusion coefficient of CO_2 was determined to be 1.23×10^{-5} cm^2/s using the chronoamperometric method. The electron transfer coefficient (α), the number of electrons involved in the rate-determining step (n_α), and the total electrons for the CO_2 reduction process on the modified electrode surface were found to be 0.19, 1, and 1.88 (approximately 2), respectively. These findings confirm that the electrochemical reduction of CO_2 results in the production of CO product on the surface of the modified electrode. Overall, this study demonstrates that the use of the Ag/rGO composite allows for the conversion of CO_2 to CO with high selectivity and a significant decrease in overvoltage.

Keywords: CO_2 *reduction, Silver* nanoparticles, *R*educed graphene oxide

References

[1] S. Overa, BH. Ko, Y. Zhao, F. Jiao, *Accounts of Chemical Research*, Electrochemical Approaches for CO_2 Conversion to Chemicals: A Journey toward Practical Applications, 55(2022)638-648.
[2] W. Gao, Y. Xu, L. Fu, X. Chang, B. Xu, *Nature Catalysis*, Experimental evidence of distinct sites for CO_2-to-CO and CO conversion on Cu in the electrochemical CO_2 reduction reaction, 6(2023)885-894.
[3] X. Zhang, X. Jin, D. Wu, Z. Tian, *The Journal of Physical Chemistry C*, Selective Electrocatalytic Mechanism of CO_2 Reduction Reaction to CO on Silver Electrodes: A Unique Reaction Intermediate, 122(2018)25447-25455.
[4] X. Zhu, J. Huang, M. Eikerling, *ACS Catalysis*, Electrochemical CO_2 reduction at silver from a local perspective, 11(2021)14521-14532.

Bi-and trimetalic selenides derived from MOFs as electrode for fabrication asymmetric supercapacitors

Farzaneh Nasiri[a], **Lida Fotouhi**[b]*

[a]*Department of Analytical Chemistry, Faculty of Chemistry, Alzahra University, Tehran, Iran*

[b]*Analytical and Bioanalytical Research Centre (ABRC), Alzahra University, Tehran, Iran*

**E-mail: lfotouhi@alzahra.ac.ir*

Abstract

To shortage of non-renewable energy and increased environmental problems development of high-performance power sources, energy storage and delivery systems becomes an urgent task and has gained significant attentions. Transition metal chalcogenides (TMCs) are commonly utilized as electrode materials in pseudocapacitive energy storage due to their ability to undergo reversible faradaic redox reactions on the electrode surface and have the potential to confront the current challenges faced by supercapacitors with their significant electroactive sites and enhanced electrochemical conductivities.

We prepared an electrode material bi-and trimetallic selenide derived from Zr-Co-MOF on nickel foam. The redox peak intensity of the mixed selenide electrodes is higher than those of the single selenide electrodes, which demonstrates the higher capacity of the mixed electrodes, primarily attributed to their broader range of oxidation states. This expanded range facilitates increased redox reactions. The Ni-Zr-Co-Se(Zr:Co 1:2, 1:1, 2:1), Ni-Co-Se(Zr:Co 0:1), Ni-Zr-Se(Zr:Co 1:0) electrodes shows a specific capacity of 388, 270, 304, 203 and 185 mA h g^{-1} at a current density of 2 Ag^{-1}, respectively. Additionally, the Ni-Zr-Co-Se electrode was used for asymmetric supercapacitors with activated carbon in an aqueous electrolyte. The assembled asymmetric supercapacitor had an operating voltage of 1.7V, a specific capacity of 84 mA h g^{-1}, an energy density of 67.4 W h kg^{-1} at a power density of 894 W kg^{-1} at a current density of 2 A g^{-1}.

To evaluate the practical utility of Ni-Zr-Co-Se/NF//AC/NF device, two of Ni-Zr-Co-Se/NF//AC/NF devices were connected in series and employed to supply power to red and green LED.

Keywords: Energy storage device, Supercapacitors, Transition metal chalcogenides, Selenides.

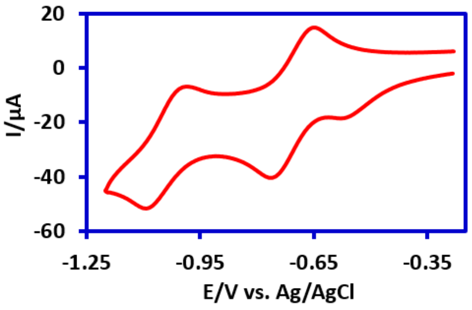
References

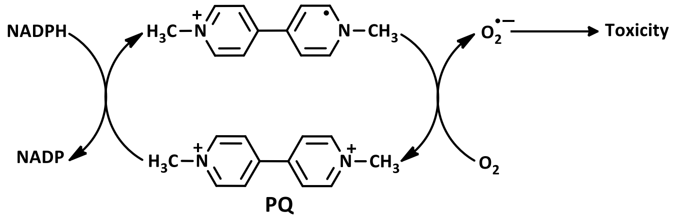
[1] C. Lamiel, I. Hussain, H. Rabiee, O. Richard, K. Zhang, *Coord Chem Rev*, 480(2023) 480:215030.
[2] X. Zhang, Q. Yin, F. Cao, Y. Wang, N. Liu, J. Liu, R. Liu, *Applied Surface Science*, 616 (2023) 156533.
[3] N. Jayababu, D. Kim, *small*, 17 (2021) 2102369.
[4] C. Zhang, Q. Sui, L. Lu, Y. Zou, F. Xu, L.Sun, C. Xiang, *Journal of Energy Storage*, 68 (2023) 107711.
[5] A. Abdi and et. al. Fuel, 336 (2023) 127066.

Comprehensive study of the electrochemical redox system of paraquat in aqueous solutions

Mahsa Roshani,[a] Davood Nematollahi[a,b]*

[a]*Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran*
[b]*Planet Chemistry Research Center, Bu-Ali Sina University, Hamedan, Iran.*
*E-mail: mahsaroshani.shimist@gmail.com





Abstract: A comprehensive and detailed study has been done on the electrochemical behavior of paraquat (**PQ**), a non-selective herbicide. This herbicide shows a very interesting electrochemical behavior due to the dimeric structure of *N*-methylpyridinium. The results of this research have led to a deeper insight and understanding of the redox properties of this interesting molecule and expanding the boundaries of knowledge about its unique properties.

Background:

PQ has been widely used for decades as an herbicide. The toxicity mechanism of **PQ** is shown below [1]. The catalytic cycle of oxygen free radicals production begins with the reduction of PQ by nicotinamide adenine dinucleotide phosphate (NADPH). This catalytic cycle also lead to the depletion of NADPH.

There is no comprehensive research on the electrochemical behavior of **PQ** in the literature. Therefore, we decided to investigate the electrochemical behavior of **PQ** in different conditions.

References

[1] R.J. Dinis-Oliveira et al. Crit. Rev. Toxicol. 38 (2008) 13–71.

Electrochemical study of pyrazinamide in water/ethanol mixture and recognizing the role of pH in its electrochemical reduction

Muhammad Alaei,[a] Davood Nematollahi,[a,b]* Niloofar Mohamadighader,[a] Mahsa Roshani,[a]
Mohammad Mehdi Hashemi-Mashouf,[a]

[a]*Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran*
[b]*Planet Chemistry Research Center, Bu-Ali Sina University, Hamedan, Iran.*
*E-mail: muhammadalaei@outlook.com

Abstract: The electrochemical behavior of pyrazinamide (**PZA**) was investigated using cyclic voltammetry. At all tested pHs, cyclic voltammograms show a pair of quasi-reversible peaks along with an irreversible anodic peak at more positive potentials. The results show that the quasi-reversible redox potentials depend on the solution pH, while the irreversible peak potential does not depend on the pH.

Background:
Symmetrical di-nitrogen heterocycles, such as **PZA**, show a wide range of biological activities. Based on in vitro and in vivo studies, **PZA** inhibits the growth of bacteria responsible for tuberculosis.

Work:
Providing new physicochemical data along with a deeper investigation of the properties of this drug in order to synthesize new and effective derivatives for the treatment of diseases such as tuberculosis and viral infections is the main motivation of this study.

Results:
The Pourbaix diagram of **PZA** showed a two-electron/three-proton process at pH < 7.0 and a two-electron/two-proton process at pH > 7.0. In addition, the calculated pK_a for reduced-**PZA** is around 7.0.

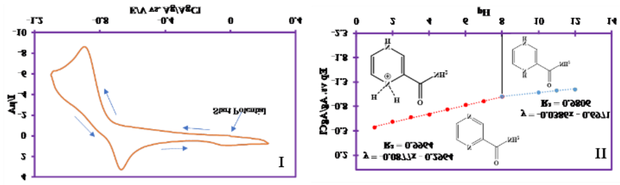


Figure 1. **I**: Cyclic voltammogram of **PZA** in water (pH = 7 buffer)/ethanol (70/30, v/v) mixture. Scan rate: 50 mV/s. **II**: The Pourbaix diagram of **PZA**.

Keywords: Pyrazinamide, Cyclic voltammetry, Electrochemical mechanism, Pourbaix diagram.

References

[1] Z. Hussain, J. Zhu and X. Ma, Drug Metab. Dispos. 49 (2021) 679.

Electrocatalytic degradation of amido black 10B using Ti/β-PbO_2-BiOx modified electrode

Mohammad Mehdi Hashemi-Mashouf,[a] Davood Nematollahi,[a,b]* Mahsa Roshani,[a]

[a]*Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran*
[b]*Planet Chemistry Research Center, Bu-Ali Sina University, Hamedan, Iran.*
*E-mail: m.hashemimashouf@che.basu.ac.ir

Abstract: Electrocatalytic degradation of amido black 10B (AB10B) (Figure 1) was successfully carried out on the surface of Ti/β-PbO_2-BiO_x modified electrode. The effect of different parameters on the removal of AB10b was investigated. The highest degradation efficiency of 99% was obtained at pH 5, current density of 300 mA/cm^{-2} and initial concentration of 100 ppm.

Background:

AB10B is one of the azo dyes extensively used in a cosmetic, printing, pharmaceutical industries, textile and food colorants. Contamination of the aquatic environment with this dye is a real problem for the environment and has a negative impact on human health [1].

Work:

Various methods have been used to treat AB10B wastewater, but these methods have disadvantages such as high energy consumption, high material cost, and low efficiency due to the high stability of dye molecule [2].

Results:

The progress of the degradation process was investigated by cyclic voltammetry and UV-vis spectroscopy. Figure 1 shows the UV-vis absorption spectra of AB10b during constant current electrolysis. As can be seen, almost all the peaks in the region of 220-800 nm have disappeared after 105 min of electrolysis.

Significance:

Compared to other reported methods, this method is simple, low-cost and very efficient, and it takes relatively little time to completely remove the dye.

Keywords: Amido black 10B, Electrocatalytic degradation, Uv–vis spectroscopy.

References

[1] W.S. Kuo, P.H. Ho, Chemosphere 45 (2001) 77–83.
[2] E. Forgacs, T. Cserhati, G. Oros, Environ. Int. 30 (2004) 953–971.

Electrochemical oxidation of phenothiazine in the presence of triphenylphosphine. Synthesis of a new phosphorus betaine compound

Mahtab Gitipeimay Hamedani,[a] Niloofar Mohamadighader,[a] Davood Nematollahi,[a,b*]
Farideh Lotfipour,[a]

[a]*Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran*

[b]*Planet Chemistry Research Center, Bu-Ali Sina University, Hamedan, Iran.*
[*]E-mail: Mahtabgitipeyma@gmail.com

Abstract: Electrochemical oxidation of phenothiazine has been studied in the presence of triphenylphosphine in water (phosphate buffer, pH 5, c = 0.2 M)/acetonitrile mixture using cyclic voltammetry. The results show that the electrochemically generated phenothiazin-5-ium participates in an addition reaction with triphenylphosphine and converts it to its organophosphorus derivative.

Background:

Organophosphorus compounds play an important role in synthetic organic chemistry from useful drugs to harmful chemical warfare gases such as sarin. Phosphorus betaines are a class of organophosphates that were first synthesized by Schonberg and then others [1-3].In the chemical synthesis of betaines, organic solvents such as benzene are used, and the syntheses are carried out under inert atmosphere conditions with low atom economy [1,2].

Results:

The results of this work show that phenothiazine at the anode surface is oxidized to phenothiazin-5-ium. Then this intermediate is attacked by triphenylphosphine and becomes the final product. The general reaction mechanism for the oxidation of phenothiazine in the presence of triphenylphosphine is presented in Scheme 1.

Significance:

Clean synthesis, using electricity instead of chemical reagents, achieving high atom economy, one-step synthesis under ambientconditions are among the prominent green advantages of this work.

Keywords: Phosphorus betaine compound, Phenothiazine, Triphenylphosphine.

References

[1] A. Schonberg, A.F.A. Ismail, *J. Chem. Soc. London* (1940) 1374–1378.
[2] B. Tapodi, et. al. Inorg. Chem. Commun. 9 (2006) 367–370.
[3] D. Nematollahi, E. Tammari, Roya Esmaili, *J. Electroanal. Chem*. 621 (2008) 113–116.

Green Synthesis of Carbon Nanocomposites Based on Sr/Fe Structures to evaluate the performance of Hydrogen Storage by Electrochemical Method

Sarina Manani[a], **M.Behpour**[a]

[a] *Department of analytical chemistry, Faculty of chemistry, Kashan university, Kashan, Iran*

[*]*E-mail: sari.mn_chem@yahoo.com*

Abstract

In this research, the goal is to store hydrogen [1]. For this purpose, activated carbon was prepared by green chemistry method [2]. Then, metal oxide nanoparticles $SrFe_{12}O_{19}$ were prepared by sonochemical method and the hydrogen storage capacity was investigated.

By comparing the results, it has been observed that the optimum ratio of activated carbon and the target material (70/30) of sample 7 in 6 M electrolyte solution has the maximum desorption capacity. The optimal sample was synthesized at a temperature of 900 degrees , at pH = 8, and then it was nanocomposited with carbon, and the XRD peaks confirm carbon and the nanostructure of $SrFe_{12}O_{19}$. EDX results indicate that the desired nanocomposite is completely purified.

The results of the BET prove that the $SrFe_{12}O_{19}$/C nanocomposite has a specific surface area. Therefore, the nanocomposite sample can be active areas. The hydrogen storage capacity for nanostructure was 385.5 mAh/g, which improved the hydrogen storage properties by adding different amounts of extracted carbon.

Keywords: Activated carbon, Green chemistry, Hydrogen storage

References**:**

[1] Tarhan, C., & Çil, M. A. (2021). A study on hydrogen, the clean energy of the future: Hydrogen storage methods. *Journal of Energy Storage*, *836-849.*

[2] Tang, S. L., Smith, R. L., & Poliakoff, M. (2005). Principles of green chemistry: PRODUCTIVELY. *Green Chemistry*, *7*(11), 761-762.

Design and synthesis of an innovative Rh(III) complex containing diphosphinoferrocene ligand: Electrochemical investigations

Shadi Mohammadian, **Mohammad Barazandeh, Sayed Habib Kazemi*, Hamid R. Shahsavari***

Department of Chemistry, Institute for Advanced Studies in Basic Sciences (IASBS), Zanjan, 45137-66731.
**E-mail: habibkazemi@iasbs.ac.ir; shahsavari@iasbs.ac.ir*

Abstract

The synthesis of novel binuclear complexes has garnered significant interest due to the versatile applications of rhodium complexes as platinum group metals (PGMs) in various fields, including photocatalysis, metallomesogens, and optoelectronic devices [1]. This study focuses on a cyclometalated rhodium complex utilizing the bidentate ligand 1,1′-bis(diphenylphosphino)ferrocene (dppf), known for its efficacy in forming chelating and cluster complexes with transition metals [2]. A new binuclear rhodium complex was successfully synthesized, and its electrochemical properties were characterized using cyclic voltammetry (CV). Measurements were conducted in a three-electrode system. Cyclic voltammograms were recorded in DMSO, revealing distinct redox behaviors indicative of the complex's stability and its considerable electronic properties [3]. According to cyclic voltammetry, it is verified that the distinct oxidation peak at -0.3 V corresponds to the Rh(I) to Rh(III) process. This research underscores the potential of dppf as a spacer in the development of PGM-based materials. The findings contribute valuable insights into the electrochemical characteristics of binuclear complexes, enhancing our understanding of their role as building blocks for advanced self-assembly and supramolecular systems. The results of this work enable the design of innovative materials for future applications across various fields.

Keywords: Rhodium complex, PGMs, Dppf, Cyclic Voltammetry.

References

[1] Jamali. S, Nabavizadeh. SM, Rashidi. M, *Inorg chem*, 47 (2008) 5441-52.
[2] Togni. A, *Mater Sci*, (1994) 433-69.
[3] Shahsavari. HR, Fereidoonnezhad. M, Niazi. M, Mosavi. ST, Kazemi. SH, Kia. R, et al. *Dalton Trans*, 46 (2017) 2013-22.

Fabrication of a Molybdenum Trioxide/Multi-Walled Carbon Nanotubes on Anodized Graphite Sheets as an Anodic Modification Material for Microbial Fuel Cells Application

Atefeh Abin[a], **Pouya Abedi**[b], **Mohammad Kazemzadeh**[b]

[a]*Department of Physical Chemistry, Faculty of Chemistry, Urmia University, Urmia, Iran*

[b]*Department of Analytical Chemistry, Faculty of Chemistry, Urmia University, Urmia, Iran*

**E-mail: Atefeh.abin74@gmail.com*

Abstract

A nanocomposite of multi-walled carbon nanotubes (MWCNTs) and molybdenum trioxide (MoO_3) nanoparticles was used as an anodic modification material in Microbial Fuel Cells (MFCs). The anode was fabricated by coating the nanoparticles on the anodized graphite sheet (G) by electrochemical deposition method. The MWCNTs-MoO_3/G showed higher performance than bare graphite sheet. Power densities of MWCNTs-MoO_3/G and bare graphite were 21.956 mWm^{-2} and 7.547 $mW.m^{-2}$ respectively [1].

The electrodes were characterized by scanning electron microscopy (SEM) and the electrochemical properties of electrode have been investigated by cyclic voltammetry (CV). MWCNTs-MoO_3/G provide a large electroactive area, high electronic conductivity, enhanced extracellular electron transfer capacity, and improved nutrient transfer capability. In addition, the formation of bacterial biofilm on the electrode surface of MFC was greatly aided by the high conductivity and wide unique surface area, which also greatly improved the charge transfer efficiency [2].

This exploratory research advances the fundamental application of anodic modification to MFCs, simultaneously providing valuable guidance for the use of carbon-based transition metal oxide nanomaterials in high-performance MFCs. Moreover, the comparison of power density between the suggested MFC and others in the literature indicated that the MWCNTs-MoO_3/G nanocomposite is an advantageous anode material for MFCs [3].

Keywords: carbon nanotubes, molybdenum trioxide, nanocomposite, anode modification, microbial fuel cell

References

[1] J. Ma, L. Wang, Y. Zhang and J. Jia, *Molecules*, 29.11 (2024).
[2] A. Mehdinia, E. Ziaei and A. Jabbari, *Electrochimica Acta*, 130 (2014) 5012-5018.
[3] P. Liang, H. Wang, X. Xia, X. Huang and Y. Mo, *Biosens, Bioelectron, 2011.*

Electrochemical late-stage modification of niclosamide, a common anthelmintic drug between humans and animals.

Haniya Rezaei[a], Davood Nematollahi[a,b]* Farideh Lotfipour[a]

, Niloofar Mohamadighader[a*]

[a]*Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran*

[b]*Planet Chemistry Research Center, Bu-Ali Sina University, Hamedan, Iran.*

* *E-mail: Haniehrezaee2000@gmail.com*

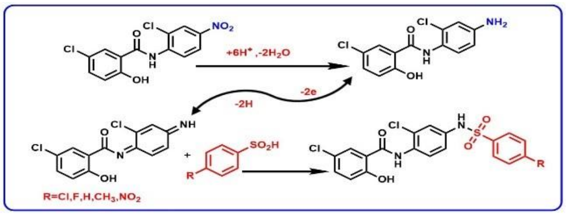
Abstract: In this research, new derivatives of nicosamide (NIC) have been synthesized through the electrolysis of nicosamide in the presence of arylsulfinic acids (ASAs) as nucleophiles, by sequential coupled electrochemical method. The nitro group in NIC is first reduced at the cathode and then oxidized at the anode. Under these conditions, the generated Michael acceptor is converted to the corresponding SU derivative in the presence of arylsulfinic acids. The synthesized compounds were tested for antibacterial activity. These results confirmed that some nicosamide derivatives show promising antibacterial activity. Therefore, in this work, we synthesized new derivatives of nicosamide for better pharmacological activity, which is known as last stage drug modification (LSMD).

Background:

Derivatives of sulfonamides are of great interest for their use in agricultural chemicals, medicinal chemistry, effective biological activities, so that they are considered one of the most important synthetic goals in organic chemistry. Sulfonamides were first recognized as antibacterials in 1900 by Gerhard Domagk.

Results:

The synthesis of these products was also constant current conditions. In this method, one of the most important factors in improving the yield and purity of the product is the applied current density. The results of these experiments are shown in Scheme1.



Scheme1. Electrochemical reaction mechanism for the synthesis of sulfonamide compounds.

Significance:

The synthesis at room temperature and atmospheric pressure, the use of an electrode as an electron source instead of toxic reagents, are among the outstanding advantages of this work.

Keywords: *niclosamide; last stage modification of drug; sulfonamides; antiparasitic drugs.*

References:

[1] D. Nematollahi, N. Mohamadighader, M. Roshani, *Electrochimica Acta*, *502*(2024)144741.
[2] B. Mokhtari, D. Nematollahi, H. Salehzadeh, *Green Chemistry*, *20* (2018) 1499-1505.
[3] M. H. Bickel, *Gesnerus*, 45 (1988). 67-86.

Fabrication of a flexible supercapacitor electrode using Co-MOF@CoS2

Hamideh Mohammadian-Sarcheshmeh[a], **Mohammad Mazloum-Ardakani**[b]*

[a,b]*Department of Chemistry, Faculty of Science, Yazd University, Yazd, Iran.*

[*] *E-mail address:* hamidehmohamadian@yahoo.com

Abstract:

Electrochemical supercapacitors (SCs) are promising energy storage devices. The application of nanostructured materials in constructing supercapacitors has strikingly expanded in the past few years. Metal-organic frameworks (MOFs) are obtaining much attention as acceptable electrodes for SCs owing to their simple tunable pore sizes, significant surface area, and structure with pseudo-capacitive redox center, and also their applications as porous carbon templates, as porous metal oxides or as a new category of active electrode materials [1]. However, MOFs exhibit poor electronic conductivity, which hinders their applications as electrode materials. Thus, it is important to use new strategies to increase their electrochemical performances. As effective and practical electrode materials, transition metal sulfides have been extensively known owing to their excellent conductivity and high capacitance. They indicate pseudocapacitive reactions with higher energy storage capacities. The MOFs, as the "sacrificial templates", can effectively be used for fabricating transition metal compounds, such as sulfides, oxides, nitrides, etc. [2, 3]. Herein, we constructed a flexible supercapacitor electrode using the synthesized Co-MOF@CoS_2. Flexible energy storage devices are important to fabrication of wearable or paper electronics in biomedical, consumer electronics, and military applications. The introduced compound has been fabricated using a simple two-step method, which was used as a flexible electrode, revealing a significant specific capacity (Csp =1032.45 F. g^{-1} at 0.003 V. S^{-1}) compared to Co-MOF (Csp = 530 F. g^{-1}). Some optimizations, such as selection of electrolyte, potential window, etc., were done. The superior properties generated from the synergistic effect between Co-MOF and CoS_2.

Keywords: MOF, Felexible supercapacitor, Transition metal sulfides

References

[1] R. Grunker, V. Bon, P. Muller, U. Stoeck, S. Krause, U. Mueller, I. Senkovska and S. Kaskel, *Chem Commun*, 50 (2014) 3450-3452.
[2] Chen C, Wu MK, Tao K, Zhou JJ, Li YL, Han X, Han L. *Dalton Trans*., 47 (2018) 5639-45.
[3] M. Azad, Z. Hussain, M.M. Baig, *Electrochim Acta*, 345 (2020) 136196.

Modified Metal–Organic Framework as electrode materials for fabrication of supercapacitor

Hamideh Mohammadian-Sarcheshmeh[a], **Mohammad Mazloum-Ardakani**[b]*
Mohammad Abdollahi-Alibeik[c], **Ardalan Sarrafnia**[d]

[a-d]*Department of Chemistry, Faculty of Science, Yazd University, Yazd, Iran.*

* *E-mail address:* hamidehmohamadian@yahoo.com

Abstract:

With the ongoing progress in society and the economy, living standards have enhanced significantly in recent years. Nevertheless, along with the fast economic prosperity, the persistent emission of sulfur dioxide (SO_2), carbon dioxide (CO_2), and some harmful gases results in environmental issues including ecological deterioration and, global warming which seriously endangers sustainable progress in human societies. The use of clean energies for example tidal energy, solar, and wind energies has been adopted to enhance continuous economic progress. However, the risk of instability and unsustainability extensively limits the corresponding large-scale applications. The fabrication and development of advanced electrochemical energy storage systems, such as supercapacitors and batteries is remarkably essential to address the principal drawbacks of clean energy systems. Supercapacitors are known as a significant category of energy storage systems that indicate higher power and energy densities compared to traditional capacitors. Metal–organic frameworks (MOFs) are a category of well-ordered crystalline porous materials [1, 2]. They have been extensively used in different fields such as sensors, energy storage, catalysis, etc. due to their porous structure, great surface chemistry, facile-to-tune pore sizes, and various functional groups. Nevertheless, some disadvantages such as their low conductivity and low active sites decrease the principal practical applications. Modified MOFs are known as types of materials with significant electrochemical performance that improve conductivity and stability of MOFs and also bridging the gap between their future applications and the basic science of MOFs. It also supplies promising opportunities to further elucidate the synergistic effects of the synthesis strategies of modified MOFs on performances [3]. In this work, the electrochemical performance of a modified Zr-MOF as an electrode active material was investigated by some electrochemical methods such as cyclic voltammetry (CV), galvanostatic charge/discharge (GCD), and electrochemical impedance spectroscopy (EIS). The obtained CVs results for the introduced modified Zr-MOF in KOH electrolyte solution (3.0 M) reveal a specific capacitance value of $C_{sp} = 255$ F g^{-1} at a scan rate of 5 mV s^{-1}.

Keywords: Metal-organic frame work (MOF), Modified, Supercapacitor

References

[1] L. He, J. Liu, L. Yang, Y. Song, M. Wang, D. Peng, Z. Zhang, S. Fang, *Electrochim. Acta*, 275 (2018) 133–144.
[2] L. Shao, Q. Wang, Z. Ma, Z. Ji, X. Wang, D. Song, Y. Liu, N. Wang, *J. Power Sources*, 379 (2018) 350–361.
[3] K. Chen, X. Li Wang, W. Hu, Q. Kong, H. Pang, Q. Xu, *Small structure*, 3 (2022) 2100200.

A green strategy for the synthesis of aryl-benzoquinone derivatives under batch and flow conditions

<u>Mozhdeh Malmir</u>,[a] Davood Nematollahi*[a,b], Ali Sadatnabi[a] Sajad Shanehsaz[a]
[a]*Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran*
[b]*Planet Chemistry Research Center, Bu-Ali Sina University, Hamedan, Iran.*
*E-mail: malmir627@gmail.com

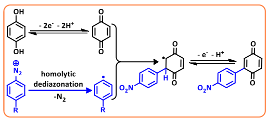
Abstract: Electrochemical methods have been developed to accelerate organic processes. These methods use electrical energy as a direct energy source without the use of reagents. On the other hand, C-C bond formation is an important step in the synthesis of chemical, pharmaceutical and biological products. In this work, an efficient electrochemical synthesis of p-benzoquinone derivatives from anilines and hydroquinones has been achieved by direct electrolysis of aqueous solution containing hydroquinones in the presence of aryldiazonium salts in both batch and continuous-flow cells.

Background:

Benzoquinones are a group of organic compounds that are involved in important biological activities such as electron transport processes, oxidative phosphorylation and bioenergetic transport. In addition, some of them have anti-cancer, anti-inflammatory and antioxidant activities [1]. Therefore, the synthesis of these compounds can be useful in the development of some medicinal molecules.

Results:

The results of this research show that hydroquinones are oxidized to the corresponding *p*-benzoquinones on the anode surface. In the next step, the aryl radical resulting from the hemolytic dediazonation of diazonium salt reacts with benzoquinone and turns into the corresponding aryl-benzoquinone after one-electron oxidation. The reaction mechanism for the synthesis of aryl-benzoquinone is presented in Scheme 1.



Scheme 1. Electrochemical arylation pathway of hydroquinone.

Significance:

This protocol is very economical due to the use of electricity and is performed under mild and safe conditions without the use of toxic solvents and catalysts. Aryl-benzoquinone derivatives were isolated in good to high yields.

Keywords: Aryl-benzoquinone, Hydroquinone, Aryldiazonium salts, Flow synthesis.

References

[1] P.R. Dandawate, A.C. Vyas, S.B. Padhye, M.W. Singh, J.B. Baruah Mini-Rev. Med. Chem. 10 (2010) 436.

Degradation cationic dye of Basic Red46 by electrochemical oxidation and reduction method

Zakieh Salehi[a], Ali Benvidi*

[a]Department of Chemistry, Faculty of Science, Yazd University, Yazd, Iran

[b]Department of Chemistry, Faculty of Science, Yazd University, Yazd, Iran

**E-mail: benvidi89@gmail.com*

Abstract

The two factors of industrialization and population growth cause pollution and water shortage. Wastewater of textile industries have adverse effects on the environment, the discharge of dye wastewater into lakes and rivers causes problems such as cancer, allergies, disruption of photosynthesis, etc. One of the promising methods for the treatment of dye wastewater is electrochemical treatment methods, which have advantage such as compatibility with the environment, being cheap, and simplicity in automation. Electrochemical technologies in to wastewater treatment include electrochemical reduction, electrochemical oxidation, electro coagulation and photo-assisted electrochemical methods. In the present study, the combination of two methods of oxidation and electrochemical reduction was used to degrade Basic Red46 (BR46) from synthetic wastewater, NO^+ and active chlorine species were generated for dye degradation through nitrate reduction on a copper electrode and chlorine oxidation on a platinum electrode, respectively. Some parameters such as potential, concentration of electrolytes and electrolysis time were investigated. As a result, the studied dye degradation efficiency and COD removal percentage from the synthetic wastewater solution in 5 min were reported as 99% and 50% respectively.

Keywords: Basic Red46; Nitrosonium; active chlorine species; COD

References

[1] Belal, Raghda M., Mohamed A. Zayed, and Nabil A. Abdel Ghany. "An Expanded IrO2/Ti Durable Electrode for Electrochemical Degradation of Basic Red 46 Textile Dye in Both Single and Binary Mixture Solutions." *Water, Air, & Soil Pollution* 234.8 (2023): 536.

[2] Sarfo, Daniel K., et al. "Electrochemical degradation and mineralisation of organic dyes in aqueous nitrate solutions." *Chemosphere* 316 (2023): 137821.

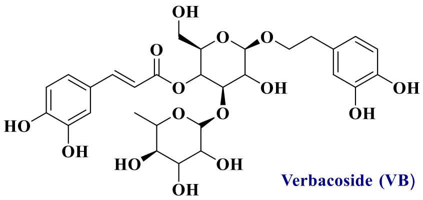
Electrochemical Assessment of Verbascoside in the Leaf Extract of *Aloysia citriodora* at the Surface of Silver Nanoparticles Modified Carbon Paste Electrode

Ameneh Amani*, Mohadese Mohtaji

[a] *Department of Chemistry, Nahavand Higher Education Complex, Bu-Ali Sina University, Hamedan, Iran*
[b] *Department of Analytical Chemistry, Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran*

**E-mail: amani@gmail.com*

Abstract. Electrochemistry, includes a huge collection of various phenomena, devices, and technologies that is widely used in all sciences and techniques [1]. On the other hand, the global market of natural products is driven by health and anti-aging products, which in most cases play an essential role against oxidative stress. Among these compounds, flavonoids and hydroxycinnamic acid derivatives, such as verbacoside (VB) (Scheme **1**), are of particular interest due to their widespread occurrence in fruits and vegetables consumed by humans [2]. Due to their inherent antioxidant power, they have received considerable attention, and pharmacological studies of VB have reported a large variety of important biological properties [3].



Scheme 1

In this work at first the biosynthesis of silver nanoparticles has been performed with the leaf extract of *Aloysia citriodora*. Synthesized nanoparticles were confirmed by UV-Visible, FT-IR, and SEM image. Silver nanoparticles, with large surface area, good biocompatibility, high conductivity and electrocatalysis characteristics, have been suitable for facilitate the transfer of electrons at the carbon paste electrode (CPE) [4]. In the second step, we constructed a sensitive electrochemical electrode based on silver nanoparticles, paraphine and graphite, as the working electrode for the electrooxidation of VB. Electrochemical behaviour of VB at the surface of this modified electrode investigated using cyclic voltammetry and differential pulse voltammetry techniques at the biological pH.

Keywords: Electrochemical Oxidation, Silver nanoparticles, Carbon paste electrode.

References

[1] C. Costentin, *Chem. Rev.* 108 (2008) 2145-2179.
[2] E. D. Souza Gil, T. A. Enache, and A. M. Oliveira-Brett, *Comb. Chem. Hight. Scr, 16 (*2013) 92-97.
[3] S.A. Schonbichler, L.K.H. Bittner, J.D. Pallua, M. Popp, G. Abel, G.K. Bonn, C.W. Huck, *J. Pharm. Biomed. Anal*., 84 (2013) 97-102
[4] J. Tashkhourian, M.R. Hormozi Nezhad, J. Khodavesi, S. Javadi, *J. Electroanal. Chem*. 633 (2009) 85-91.

Electrochemical study and Assessment Antioxidant Activity of Ethanolic Leave Extract of *Lavandula*

Ameneh Amani[a]*, Armita Damsaz[a], Mohadese Mohtaji[c]

[a,b] *Department of Chemistry, Nahavand Higher Education Complex, Bu-Ali Sina University, Hamedan, Iran*
[c] *Department of Analytical Chemistry, Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran*

E-mail: amani@gmail.com

Abstract Many human diseases are caused or negatively affected by free radicals. The natural defense of the human organism against free radicals is not always sufficient mainly due to the significant exposition to free radicals from external sources in the modern world. The dietary intake of antioxidants plays an important role in the protection of the human organism againts free radicals. Many clinical and epidemiological studies show a connection between the antioxidant activity of the substances present in the diet and the prevention from such diseases as cardiovascular diseases or carcinogenesis. Fruits, vegetables, grains, teas, and some kinds of spices are natural sources of antioxidants [1,2]. *Lavender* is a perennial and evergreen plant of *Lamiaceae* (the mint family) with blue, purple, and very fragrant flowers that has been used in traditional medicine [3]. This medicinal plant is widely used in folk medicine in different parts of the world and especially distinguished as an antiseptic.

In this work, a simple and sensitive electrochemical method for the evaluation of antioxidant capacity of ethanolic leave extract of *lavandula* has been developed. The electrochemical oxidation of leave extract of *lavandula* has been investigated by cyclic voltammetry and Differential pulse voltammetry (DPV) techniques. The results show that *lavandula* ethanolic extract oxidize at low potentials in comparison of galic acid, salicilic acid and quercetin as standard antioxidants. Also, Antioxidant activities of this extract was evaluated using the 2,2-diphenyl-2-picrylhydrazyl (DPPH) radical-scavenging method and it is directly related to its redox potential value. The results show the good antioxidant activity of the *lavandula* extract.

Keywords: Electrochemical oxidation, Antioxidant Activity, Lavandula.

References

[1] L. Buřičová, Z. Réblová, *Czech J. Food Sci*. 26 (2018) 132-138.
[2] D.A. Hughes, *Nutrition Bulletin*, **25** (2000) 35-41.
[3] Y. E. zoubi, D. Bousta and A. Farah, *Clinical Phytoscience*, 6 (2020) 9.

A sensitive electrochemical sensor based on glassy carbon electrode modified with microporous activated carbon derived from eucalyptus barks and Cu-BTC for determination of phosalone

Faezeh Alipour[a], **Jahan Bakhsh Raoof**[a]*, **Reza Ojani**[a]

[a] *Department of Analytical Chemistry, Faculty of Chemistry, University of Mazandaran, Babolsar, Iran*

**E-mail:* *alipour14001@gmail.com*

Background:

Among the various materials that are employed to enhance the electrochemical response of sensors, activated carbon (AC) compared to other similar carbon materials, such as graphene and carbon nanotubes, enjoys relatively more feasible preparation and practical applications [1,2]. It is important to provide environmentally friendly, affordable and efficient carbon materials.

Results:

Herein, Cu-BTC metal organic framework was prepared through one-step solvothermal method. Moreover, an available and cheap biomass called eucalyptus bark was used to prepare AC through carbonization and activation processes. Then, a simple electrochemical sensor was employed based on GCE modified by microporous AC and Cu-BTC (AC/Cu-BTC/GCE) for voltametric determination of phosalone as an organophosphate pesticide using differential pulse voltammetry (DPV) method. A high binding affinity can be observed between phosalone and Cu-BTC, which forms a barrier for electron transfer of Cu-BTC. Therefore, in the presence of phosalone, the number of active copper ions involved in the redox reaction decreases with the formation of the phosalone-Cu(II) complex. Under optimal conditions, the mentioned sensor exhibited an ultralow detection limit of 6.94×10^{-13} M and a wide linear range of 1.0×10^{-12} – 1.0×10^{-9} and 1.0×10^{-9} - 1.0×10^{-5} M. Also, different fruit juices including cherry, apple and peach and agricultural water were selected as real samples.

Significance:

Also, the prepared electrochemical sensor was studied in terms of repeatability, selectivity and stability and the results confirmed that the proposed AC/Cu-BTC/GCE can serve as an efficient electrochemical sensor for voltammetric determination of phosalone.

Keywords: Organophosphorus pesticides; Activated carbon; Biomass; Metal organic framework; Phosalone; Electrochemical sensor

References

[1] X. Xiao, L. Li, H. Deng, Y. Zhong, W. Deng, Y. Xu, Z. Chen, J. Zhang, X. Hu, Y. Wang, Biomass-derived 2D carbon materials: structure, fabrication, and application in electrochemical sensors, J. Mater. Chem. B 11(45) (2023) 10793-10821.

[2] V.S. Bhat, S. Supriya, G. Hegde, Biomass derived carbon materials for electrochemical sensors, J. Electrochem. Soc. 167(3) (2019) 037526.

Comparison efficiency of different hybrids of cobalt phthalocyanine and ionic liquid derived ordered mesoporous carbons as catalyst for electrochemical reduction of carbon dioxide

Samin Barat-Abtahi[a], Fahimeh Varmaghani[a] *, Babak Karimi[a] *

[a]*Department of Chemistry, Institute for Advanced Studies in Basic Sciences (IASBS), Zanjan, 45137-66731, Iran*

[*] *E-mail: f.varmaghani@iasbs.ac.ir, karimi@iasbs.ac.ir*

Human activities specially consumption of fossil fuels have resulted in tremendous carbon emissions, which are responsible for a series of environmental problems such as global warming. As a result, electrocatalytic CO_2 reduction (eCO_2RR) has received widespread attention in recent years with the aim of production of high value-added products from carbon dioxide [1]. In this regard, different materials have been assessed in order to achieve excellent catalytic performance towards CO_2 reduction. Among materials, Ordered Mesoporous Carbons (OMCs) have been extensively investigated for use in electrochemistry in recent years due to high electrical conductivity, remarkable accessible surface and uniform ordered mesochannels [2]. OMCs can be used in the pure form as well as in composite form with metal oxides, metal complexes and nanoparticles to reduce carbon dioxide [3]. The chemical, textural and structural properties of ordered mesoporous carbons are completely influence the electrocatalytic behaviour. In this work, focusing on the role of carbon, various hybrids of cobalt phthalocyanine and different ionic liquid derived ordered mesopros carbons were obtained by carbonizing a homogeneous mixture of 1-methyl-3-phenethyl-1*H*-imidazolium hydrogen sulfate as carbon sources in the presence of SBA-15 mesoporous silica as a hard scaffold, and their potential for CO_2 reduction was evaluated. We found that the kind of doped heteroatoms, template, temperature of carbonization,… are key parameters affected on electrocatalytic behaviour. The efficiency of the cell was further enhanced by designing a paired electrolyzer in which the slow oxygen production process replaced with the synthesis of arylsulfonyl-4,4'-biphenol in green conditions.

Keywords: Ionic liquid derived ordered mesoporous carbon (IOMC), Electrocatalytic CO_2 reduction reaction (CO_2RR), Electrocatalyst

References

[1] M. Wang, K. Torbensen, D. Salvatore, S. Ren, D. Joulie, F. Dumoulin, D. Mendoza, B. Lassalle-Kaiser, U. Isci, C. P. Berlinguette and M. Robert, *Nat. Commun.*, 10 (2019) 3602.
[2] M. T. Ghafari, F. Varmaghani, B. Karimi and V. Khakyzadeh, *Analyst*, 145 (2020) 596.
[3] S. Barat-Abtahi, F. Jafari-Hafshejani, F. Varmaghani, B. Karimi, H. H. Veisi, *Green Chem*., 26 (2024) 362.

Surface modification of glassy carbon electrode by using MIL-101 (Fe)-NH_2 /MWCNTs nanostructure for determination of doxorubicin in the presence of dacarbazine

Zahra Ghasemi[a*], **Hadi Beitollahi**[b], **Fariba Garkani Nejad**[b] , **Zahra Dourandish**[b]

[a]*Department of Chemistry, Graduate University of Advanced Technology, Kerman, Iran*

[b]*Department of Environment, Institute of Science and High Technology and Environmental Sciences, Graduate University of Advanced Technology, Kerman, Iran*

[*]*E-mail: zahra.ghasemii19778@gmail.com*

Abstract

Chemotherapy is considered as one of the widely used cancer treatment methods. Chemotherapy works by destructing or controlling the growth of cancer cells with using chemical drugs [1]. However, chemotherapy causes side effects due to these drugs can affect and damage healthy cells in addition to cancer cells [2]. Therefore, in order to reduce the side effects of chemotherapy and improve the effectiveness of treatment, determination of chemotherapy drugs by using a simple, sensitive, and fast analytical method is very important [3]. In the present work, a novel electrochemical sensor was designed based on glassy carbon electrode (GCE) modified with MIL-101 (Fe)-NH_2 metal-organic framework/multi-walled carbon nanotubes (MIL-101 (Fe)-NH_2 MOF/MWCNTs) nanostructure for determination of doxorubicin (DOX) in the presence of dacarbazine (DTIC). Under optimized conditions, MIL-101 (Fe)-NH_2/MWCNTs/GCE showed a broad linear detection range (0.005 to 100.0 µM) for DOX. Also, the limit of detection was found as 0.0016 µM for DOX. Moreover, DOX and DTIC were successfully determined simultaneously at the surface of modified GCE. Finally, determination of these drugs in pharmaceutical samples were investigated and good recoveries were obtained. Based on the obtained results, the proposed sensor can be used as an effective tool in quality control and pharmaceutical studies.

Keywords: Cancer, Chemotherapy, Electrochemical sensor, Doxorubicin, Dacarbazine.

References

[1] G. Wei, Y. Wang, G. Yang, Y. Wang and R. Ju, Theranostics, 11 (2021) 6370.
[2] F. Ades, K. Tryfonidis and D. Zardavas, Ecancermedicalscience, 11 (2017) 746.
[3] Z. Wang, H. Wang, M. Cao and Y. Liu, Alexandria Engineering Journal, 93 (2024) 51-58.

D ZIF-L (Zn, Co)/MWCNTs nanostructure modified carbon paste electrode as an efficient electrochemical sensor for determination of norepinephrine in the presence of L-tyrosine

Ahlam Bazrafkan[a,*], **Hadi Beitollahi**[b], **Fariba GarkaniNejad**[b], **Reza Zaimbashi**[b]

[a]*Department of Chemistry, Graduate University of Advanced Technology, Kerman, Iran*

[b]*Environment Department, Institute of Science and High Technology and Environmental Sciences, Graduate University of Advanced Technology, Kerman, Iran*

**E-mail:* ahlambz79@gmail.com

Abstract

Neurotransmitters are biologically active species that are known as chemical messengers in the nervous system. Neurotransmitters involved incarrying, boosting and balancing signals between neurons and target cells throughout the body [1]. Norepinephrine (NEP) is a neurotransmitter in the nervous systems that plays an important role in the physical and psychological functions of body [2]. L-tyrosine (L-Tyr) is one of then on-essential amino acids that plays a role as a precursor in the synthesis of catecholamines such as norepinephrine, and etc. Therefore, it is important to determine NEP in the presence of L-Tyr. Electrochemical sensors based on nanostructures due to high sensitivity are widely used analytical tools in the analysis of compounds. In the present study, the prepared multi-walled carbon nanotubes (MWCNTs)/zeolitic imidazolate framework (ZIF-L (Zn, Co)) nanostructure was used for modification of carbon paste electrode (CPE) to prepare an electrochemical sensor for determination of NEP in the presence of L-Tyr. Based on voltammetric measurements, the response of the prepared sensor showed a suitable linear dependence in the concentration range of 0.01 to 800.0 µM NEP with detection limit of 0.003 µM. Also, voltammetric measurements of NEP were performed in the presence of L-Tyr and distinct oxidation peaks were observed for these species. Moreover, an investigation was performed to the determination of NEP and L-Tyr in the real samples, demonstrating the practical application of the designed sensor. In summary, the designed sensor in this study showed good performance for determination of NEP and L-Tyr, making it suitable for practical analysis.

Keywords: Neurotransmitter, Nervous system, Electrochemical sensor, Norepinephrine, L-tyrosine.

References

[1] R.I.Teleanu, A.G.Niculescu, E. Roza, O.Vladâcenco, A.M.Grumezescu and D.M. Teleanu, *International Journal of Molecular Sciences*, 23 (2022) 5954.

[2] M.A. Farahmand Nejad, F. Ghasemi and M.R. Hormozi-Nezhad, *Analytica Chimica Acta*, 1039 (2018) 124-131.

Designing a novel and sensitive electrochemical sensing platform for determination of methotrexate in the presence of calcium folinate

Zahra Ghasemi[a*], **Fariba Garkani Nejad**[b], **Zahra Dourandish**[b], **Hadi Beitollahi**[b]

[a]*Department of Chemistry, Graduate University of Advanced Technology, Kerman, Iran*

[b]*Department of Environment, Institute of Science and High Technology and Environmental Sciences, Graduate University of Advanced Technology, Kerman, Iran*

[*]*E-mail:* zahra.ghasemii19778@gmail.com

Abstract

Methotrexate (MTX), a structural analog of folic acid, known as one of the most potent and widely used medications for the treatment of different types of cancer and autoimmune diseases [1, 2]. Methotrexate works by inhibiting the activity of dihydrofolate reductase enzyme, which prevents the conversion of dihydrofolate to tetrahydrofolate and ultimately leads to the inhibition of growth and division of cells [3]. However, the long-term treatment with MTX can cause various side effects. The toxic action of MTX is prevented by calcium folinate (CF). Therefore, the simultaneous determination of MTX and CF is very important. Among different methods, electrochemical methods due to their rapid response and high sensitivity have been widely used in the development of sensors. In this work, we designed an electrochemical sensing platform based on glassy carbon electrode (GCE) modified with MIL-101 (Fe)-NH_2 metal-organic framework/multi-walled carbon nanotubes (MIL-101 (Fe)-NH_2 MOF/MWCNTs) nanostructure for determination of MTX in the presence of CF. Due to the synergistic effects of MWCNTs and MIL-101 (Fe)-NH_2, the designed sensor exhibited good performance towards the oxidation of MTX. Based on the quantitative measurements, the MIL-101 (Fe)-NH_2/MWCNTs/GCE sensor demonstrated a suitable linear response for MTX in the concentration range of 0.1 to 300.0 µM. The limit of detection was calculated as 0.04 µM. Also, the prepared sensor showed good performance for determination of MTX in the presence of CF. Finally, based on the results from the analysis of pharmaceutical samples, this sensor has good potential applications in quality control of pharmaceutical samples.

Keywords: Cancer, MIL-101 (Fe)-NH_2 MOF/MWCNTs nanostructure, Electrochemical sensor, Methotrexate, Calcium folinate.

References

[1] M.K. Ahirwar, V. Yogi, O.P. Singh, H.U. Ghori, V. Tiwari and B. Francis, Clinical Cancer Investigation Journal, 7 (2018) 221-226.
[2] D. Ezhilarasan, Toxicology, 458 (2021) 152840.
[3] Z. Deng, H. Li, Q. Tian, Y. Zhou, X. Yang, Y. Yu and T. Zhou, Microchemical Journal, 157 (2020) 105058.

Modified carbon paste electrode-based electrochemical sensor for voltammetric determination of dopamine in the presence of uric acid

Ahlam Bazrafkan[a,*], Fariba GarkaniNejad[b], Hadi Beitollahi[b], Reza Zaimbashi[b]

[a]*Department of Chemistry, Graduate University of Advanced Technology, Kerman, Iran*

[b]*Environment Department, Institute of Science and High Technology and Environmental Sciences, Graduate University of Advanced Technology, Kerman, Iran*

**E-mail: ahlambz79@gmail.com*

Abstract

Dopamine is a key catecholamine neurotransmitter involved in the various physiological processes in the brain. The deficiency levels of dopamine in the brain are related with the various neurological disorders such as Parkinson's disease, and etc. [1]. Also, the high levels of dopamine cause many problems. Uric acid is a biological compound that is naturally produced in the human body. However, high levels of uric acid in biological fluids can lead to Hyperuricemia, which causes various diseases [2]. Therefore, due to the vital physiological functions of dopamine and uric acid and their simultaneous presence in biological fluids that can cause interference in determinations, it is very essential to determine them simultaneously. Herein, a carbon paste electrode (CPE) modified with multi-walled carbon nanotubes (MWCNTs)/zeolitic imidazolate framework (ZIF-L (Zn, Co)) nanostructure was used as an electrochemical sensor for determination of dopamine in the presence of uric acid. The MWCNTs/ZIF-L (Zn, Co)/CPE showed good electrochemical activity, and the electrochemical response for dopamine was found to be linear in the concentration range of 0.001 to 900.0 µM with detection limit (LOD) of 0.7 nM. Also, the overlapping anodic peaks of dopamine and uric acid was solved at the surface of modified CPE and their simultaneous determination was possible. Finally, the applicability of the designed sensor was evaluated in the pharmaceutical and biological samples and good results were obtained. This sensing platform presents a promising tool for determination of these compounds.

Keywords: Parkinson's disease, Neurotransmitter, Electrochemical sensing platform, Dopamine, Uric acid.

References

[1] V.Kathiresan, D. Thirumalai, T.Rajarathinam, M.Yeom, J.Lee, S.Kim and S.C. Chang, *Journal of Analytical Science and Technology*, 12 (2021) 1-10.

[2] J. Nong, N.Zhang, A.Wen and C. Hu, *Journal of Electroanalytical Chemistry*, 952 (2024) 117982.

Binary Metal Organic Frameworks Derived Hierarchical Hollow microspheres Ni/Co@Carbon composites as an efficient bifunctional electrocatalysts for Overall Water-Splitting

Laleh Sharif [a,b], **Ali Benvidi** [a,*], **Sedigheh Zeinali** [b] , **Behzad Haghighi** [c]

[a] *Department of Chemistry, Faculty of Science, Yazd University, Yazd, Iran*
[b] *Nanochemical Engineering Department, Faculty of Advanced Technologies, Shiraz University, Shiraz, Iran*
[c] *Department of Chemistry, College of Sciences, Shiraz University, Shiraz, Iran*

[*]*E-mail: laleh.sharif@gmail.com & abenvidi@yazd.ac.ir*

Abstract

Development of efficient, earth-abundant and low-cost electrocatalyst for effective water electrolysis is highly demanding for production of sustainable hydrogen energy. Recently, metal–organic frameworks as promising porous hybrid materials have been widely used in electrocatalytic applications [1-2].Herein, Binary Ni/Co MOFs with a hollow-sphere structure that is decorated with cone-shaped protrusions were prepared via a facile solvothermal reaction. Nickel nitrate and cobalt nitrate were used as a metal ion sources, while trimesic acid and PVP were used as the organic linker and the stabilizing agent to help the formation of a regular spherical structure for the growth of MOFs, respectively. In order to overwhelm the poor electrical conductivity, the as-synthesized Ni/Co-BTC MOFs precursor was carbonized to obtain hollow sphere Ni/Co@Carbon composites. During this one-step annealing strategy, the Ni, and Co ions were converted into metallic Ni, and Co nanoparticles and the organic ligands of the Binary Ni/Co MOFs were pyrolyzed into highly graphitized carbon layers, respectively. Afterwards Ni/Co@Carbon composites modified glassy carbon electrode showed superior OER and HER activity in 1 M KOH solution.

In summary, the superior OER and HER catalytic performance of Ni/Co@C composites can be ascribed to its spherical hollow structures, and multicomponent synergistic effects, which provide amount of accessible active sites. Remarkably, the hollow interior leads to fast mass transport, improving conductivity and expediting electronic transfer.

Keywords: metal-organic frameworks, Overall water splitting, Bifunctional catalyst

References

[1] S. F. Nami-Ana , S. Zeinali, *Applied Energy,* 350 (2023) 121755.

[2] A.Hanan, M. Lakhan, F. Bibi , A. Khan , I. Ali Soomro, A. Hussain, Umair Aftab, *Chemical Engineering Journal* 482 (2024) 148776.

Fabrication of PDA@Bio-MOF-11@Nano-Curcumin as a Smart and Green Coating to Prevent Mild Steel Corrosion

Shokoufeh Rezvani nia[a], Ali Benvidi[a,*] Hamid Reza Zare[a], Marzieh Dehghan Tezerjani[a]

[a]*Department of Chemistry, Yazd University, Yazd, 89195–741, Iran*

[*]*E-mail address: abenvidi@yazd.ac.ir*

Sh.rezvan72@yahoo.com

Abstract Corrosion is a destructive phenomenon that causes a lot of economic, safety and environmental damages. So, many studies have been conducted in the field of the corrosion prevention. Inorganic inhibitors were mostly used to corrosion prevention but they have some deficiencies like toxicity and harmful effects on the environment. Therefore, nowadays the biocompatible inhibitors have been introduced [1,2]. Green inhibitors have received much attention due to their biocompatibility and cost-effectiveness [3,4]. In this research, a smart coating based on poly dopamine biopolymer including a metal organic framework and nano-curcumin (Bio-MOF-11@Cur NPs) receptor was synthesized. To investigate the characteristics and morphology of the synthesized coating as a green inhibitor coating, the various techniques of Fourier-Transform infrared spectroscopy (FT-IR), X-Ray diffraction (XRD), ultraviolet-visible spectroscopy (UV-Visible), scanning electron microscopy (SEM) and energy dispersive X-Ray analysis (EDS) were used. The UV-Vis technique was applied for the effect of inhibitor release study at pH = 4.0 and pH =7.0 (the maximum amount of inhibitor release after 72 h obtained 86.61ppm at pH 4.0). For electrochemical studies on a mild steel (MS) in NaCl solution (3.5%), the electrochemical impedance spectroscopy (EIS) and Tafel plot were used. Finally, the inhibition rate of the constructed coating was evaluated to be 95.08%, which indicated the good performance of the PDA@Bio-MOF-11@Cur NPs coating for corrosion protection of MS in NaCl solution (3.5%).

Keywords: Corrosion, Smart coating , Biopolymer of poly dopamine, Nano-Curcumin.

References

[1] R. Bender, D. Féron, D. Mills, S. Ritter, R. Bäßler, D. Bettge, I. De Graeve, A. Dugstad, S. Grassini, T. Hack, *Materials and corrosion* 73(11) (2022) 1730-1751.
[2] Q. Zhang, R. Zhang, R. Wu, Y. Luo, L. Guo, Z. He, *Journal of Adhesion Science and Technology* 37(9) (2023) 1501-1524.
[3] E. Florez-Frias, V. Barba, R. Lopez-Sesenes, L. Landeros-Martínez, J.F.-D. los Ríos, M. Casales, J. Gonzalez-Rodriguez, *UInternational Journal of Corrosion* 2021(1) (2021) 6695299.
[4] H. Wei, B. Heidarshenas, L. Zhou, G. Hussain, Q. Li, K.K. Ostrikov, *Materials Today Sustainability* 10 (2020) 100044.

Fabrication of Chitosan/GON/Rosemary/Zn as a Green Coating to Protect Copper Metal from Corrosion

Shokoufeh Rezvani nia[a], Ali Benvidi[a,*] Hamid R. Zare[a], Marzieh Dehghan Tezerjani[a]

[a]*Department of Chemistry, Yazd University, Yazd, 89195–741, Iran*

[*]*E-mail address:* : *abenvidi@yazd.ac.ir*
Sh.rezvan72@yahoo.com

Abstract Corrosion is an irreversible electrochemical process. Due to the advancement of technology, as well as economic losses and irreparable damages of corrosion, many studies have been done to prevent it [1]. The main focus in the field of corrosion is the use of biocompatible and non-toxic coatings and inhibitors to replace toxic and hazardous substances such as chromates, phosphates, azole compounds, etc [2]. Natural plant extracts have received much attention due to their non-toxicity and cost-effectiveness [3]. In this paper, the anti-corrosion effect of a constructed film based on the chitosan nanocomposite (green matrix), graphene oxide nano sheets (GON) and rosemary plant extract on the copper metal was studied. The characterization study of the synthesized materials was investigated using Fourier transform infrared spectroscopy (FT-IR) and X-Ray diffraction analysis (XRD) techniques. The anti-corrosion property of the synthesized coating was studied using electrochemical impedance spectroscopy (EIS). The highest value of transfer resistance is $2.46*10^4$ $\Omega.cm^2$, which is related to Chitosan/GON/Rosemary/Zn coating. The surface studies were performed using SEM and EDX techniques and finally the release of the inhibitor was investigated using UV- visible spectroscopy. The highest amount of inhibitor released after 24 h in acidic environment was reported to be 65.79 ppm.

Keywords: Corrosion, Green inhibitor, Copper, Chitosan.

References

[1] S.K. Sharma, A. Mudhoo, E.K.E. Khamis, G. Jain, *Journal of Corrosion Science and Engineering* 11 (2008) 1-14.

[2] S. Zehra, M. Mobin, J. Aslam, *Elsevier* (2022), pp. 251-268.

[3] A. Dehghani, B. Ramezanzadeh, *Industrial Crops and Products* 193 (2023) 116183.

Construction of a NEW bimetallic Metal Organic FRAMEWORK: Preparation and Physicochemical Characterization by Surface Analysis Techniques and Electrochemical Methods

Reza Karimi Shervedani[*], **Mohammad Reza Namazizade**

Department of Chemistry, University of Isfahan, Isfahan, 8174673441, Islamic Republic of Iran
[*]E-mail: rkarimi@sci.ui.ac.ir (R. Karimi Shervedani)

Abstract: In this work, a new bimetallic metal-organic framework (MOF) is made using a simple method without the need of organic solvents. The prepared MOF is characterized by different methods such as X-ray diffraction, Infrared spectroscopy, Thermogravimetry, and electrochemical techniques. High stability with a wide potential window, which is an advantage for electroanalytical application, was observed.

Background:

The MOFs are porous and crystalline materials made of metal ions and organic ligands [1]. Due to having features such as porous structure and high surface area, these materials are interesting for use in various fields such as drug delivery, separation, Energy storage (gas, charge, etc.) preparation of catalysts, electrocatalysts, and sensors, [2]. Among the large number of reported structures, MOFs based on carboxylate ligands and high-valency metal ions have attracted considerable attention due to their high stability [3]. Here, synthesis and behavior of a new bimetallic MOF is reported.

Results:

The results obtained from analysis of XRD, FTIR, TGA, LSV and EIS data supported successful formation of the bimetallic MOF, with high stability, low catalytic activity for HER/OER and a wide potential window, almost 2.7 V (-1.1 to +1.6 V) offering a wide potential window for electroanalytical application.

Significance:

The obtained MOF with high stability, low catalytic activity for HER/OER, offers a wide potential window for water oxidation-reduction, which in turn is an advantage for application in electroanalysis. These activities are under investigation and progress.

***Keywords**:* Metal-organic framework, Electroanalytical application, Potential window, HER/OER

References

[1] R. T. Jerozal, T. A. Pitt, S. N. MacMillan, and P. J. Milner, Journal of the American Chemical Society, 145 (2023) 13273.
[2] M. Safaei, M. M. Foroughi, N. Ebrahimpoor, S. Jahani, A. Omidi, and M. Khatami, TrAC Trends in Analytical Chemistry, 118 (2019) 401-425.
[3] A. J. Howarth et al, Nature Reviews Materials, 1 (2016) 1-15.

Electrochemical late stage modification of clonazepam: A green strategy for the synthesis of sulfonamide derivatives

Zahra Godini,[a] **Davood Nematollahi**[*a,b], **Niloofar Mohamadighader** [a]

[a]*Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran*

[b]*Planet Chemistry Research Center, Bu-Ali Sina University, Hamedan, Iran*
[*]*E-mail: godini.zahra97@gmail.com*

Abstract: Synthesis of new pharmaceutical derivatives using last stage modification (LSM) of drugs has attracted our attention in this work [1,2]. We performed the electrochemical synthesis of new clonazepam (**CZP**) derivatives in the presence of arylsulfinic acid (**ASA**) derivatives. The electrochemical synthesis of these compounds has been carried out in an undivided cell equipped with graphite anode and stainless steel cathode in water/ethanol mixture under controlled potential conditions.

Background:

Clonazepam is a benzodiazepine used for diseases of the nervous system. Commonly used drugs such as clonazepam require the synthesis of new derivatives with the aim of improving performance in terms of effectiveness, and this made us determined to carry out this project and synthesize new derivatives of this drug.

Results:

In this work, we investigated the electrochemical behavior of clonazepam (Figure1) and performed the electrochemical synthesis of clonazepam in the presence of **ASA**. The clonazepam nitro group is reduced to the amine at the cathode (C_1), the amine is oxidized at the anode (A_1), and the final structure is formed in the presence of the **ASA** (Scheme1). We also performed molecular docking studies and obtained promising results.

Significance:

CZP derivatives were synthesized under facile and environmentally friendly conditions without the need for catalysts, reagents or toxic solvents.

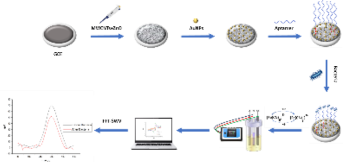
Keywords: Electrochemical synthesis; Clonazepam; late-stage modification.

References

[1] Y. Wang, S. Dana and H. Long, *Chemical Reviews*, 123(2023) 11269
[2] D. Nematollahi, N. Mohamadighader and M. Roshani, *Electrochimica Acta*, 502(2024) 1447

A Novel Label-Free electrochemical Aptasensor for Highly Sensitive Detection of Acinetobacter baumannii Using Fast Fourier Transform Square Wave Voltammetry

Paria Khajavi [a], **Negar Heidari** [a], **Sharmin Kharazi** [b], **Yusef Erfani** [c], **Parviz Norouzi***[a]
[a] *Center of Excellence in Electrochemistry, Faculty of Chemistry, University of Tehran, Tehran, Iran*
[b] *Department of Medical Nanotechnology, School of Advanced Technologies in Medicine, Tehran University of Medical Sciences, Tehran, Iran.*
[c] *Department of Laboratory Sciences, School of Allied Medical Sciences, Tehran University of Medical Sciences, Tehran, Iran*
**E-mail:* paria.khajavi@ut.ac.ir



In this study, we developed a novel electrochemical aptasensor for the ultrasensitive detection of Acinetobacter baumannii (AB), an opportunistic pathogen of significant clinical importance due to its antibiotic resistance. AB is commonly found in the environment and can cause both community-acquired and hospital-acquired infections. Rapid detection of AB is crucial for preventing further infections, optimizing treatment efficacy, and reducing healthcare costs [1].

The sensor was constructed by modifying a glassy carbon (GC) electrode with a nanocomposite of multi-walled carbon nanotubes and zinc oxide (MWCNTs-ZnO), which significantly enhanced the electrochemical signal. Subsequently, gold nanoparticles (AuNPs) were electrodeposited onto the modified electrode surface, further increasing conductivity and surface area, thereby amplifying the electrochemical response and improving sensor sensitivity.

The aptasensor was completed by immobilizing an aptamer on the modified electrode surface. We characterized the developed aptasensor using field emission scanning electron microscopy (FE-SEM), cyclic voltammetry (CV), and electrochemical impedance spectroscopy (EIS).

Quantitative analysis of AB was performed using the fast Fourier transform square wave voltammetry (FFT-SWV) technique, with all measurements conducted in a $[Fe(CN)_6]^{3-/4-}$ redox probe solution. Under optimal conditions, the aptasensor exhibited a linear detection range for AB from 10.0–1.0×10^8 CFU/mL, with an impressively low detection limit of 1 CFU/mL, which is lower than that achieved by the ELISA method for AB detection. The aptasensor demonstrated excellent reproducibility, high sensitivity, and good stability, making it suitable for low-level detection of AB in clinical applications.

Keywords: Label-Free electrochemical Aptasensor, Acinetobacter baumannii, Fast Fourier Transform Voltammetry, multi-walled carbon nanotubes, zinc oxide

References

[1] C. Whiteway, A. Breine, C. Philippe, and C. Van der Henst, "Acinetobacter baumannii," *Trends in Microbiology*, 30(2) (2022) 199-200.

Green electrochemical complexation of cephalosporins with silver, copper, iron, nickel and zinc cations

Shima Ghasemi[a], Zahra Godini[b], Davood Nematollahi[b.c*]
[a] *Department of Chemistry, Science and Research Branch, Islamic Azad University, Tehran, Iran*

[b]*Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran*

[c]*Planet Chemistry Research Center, Bu-Ali Sina University, Hamedan, Iran*
[*]*E-mail: shima ghasemi521@gmail.com.*

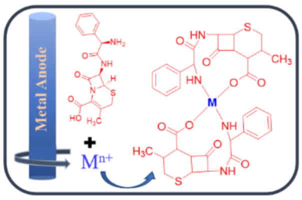
Abstract: Electrochemical complexation of cephalosporin drugs with silver, copper, nickel, iron and zinc cations was carried out galvanostatically in an undivided electrolytic cell equipped with a sacrificial anode and a stainless steel cathode under green conditions in one step without the need for metal salts.

Background:

Cephalosporins are one of the oldest antibiotics used to treat many diseases. On the other hand, combining drugs with metal ions may diversify their types and increase their medicinal properties [1]. On the other hand, since drug resistance is one of the problems of human society, the complexation of drugs may overcome this problem to some extent. The mentioned cases led us to the complexation of these drugs.

Results:

In this method, metal ions are produced from a sacrificial anode. Then the formed ions react with the drug as a ligand in the electrochemical cell and drug-complex is produced (Scheme 1). It should be noted that the cathodic reaction in these cells reduces water molecules and the formation of hydroxide ions. New compounds were characterized physically such as shape, color, melting point and IR spectroscopy and compared with other references.



Scheme 1. Complexation mechanism of cephalosporin drugs with metal ions

Significance:

This method provides an efficient and green strategy for the complexation of cephalosporin drugs in one step without the need of metal salts and with high purity and yield.

Keywords: Cephalosporin, Metal complex, Electrochemical complexation.

References

[1] S. B. Zangade, B. Sainath, *Medicinal Chemistry*, 24 (2024) 1046.

Evaluation of electrical resistance activation energy of Ni-Co-Mn-CeO_2 coated AISI 430 steel for SOFC application

Sahar Shakiba [a], Hadi Ebrahimifar [a]* , Mohammad Sefidbakht [b], Saba Dehghgan [c]

[a] *Department of Materials Engineering, Faculty of Mechanical and Materials Engineering, Graduate University of Advanced Technology, Kerman, Iran.*
[b] *Refinery and Foundries factory, Sarchesheme copper complex.*
[c] *Department of Materials Engineering, Faculty of Engineering, Shahid Chamran University of Ahvaz, Ahvaz, Iran.*

* *H.Ebrahimifar@kgut.ac.ir*

Abstract

Solid oxide fuel cells (SOFCs) are classified as intermediate temperature (650–800 °C) fuel cells. Individual planar SOFCs are connected in a stack with electronically conducting plates called interconnects. The desirable properties of interconnects include mechanical stability at the operating temperature, thermal and chemical compatibility with the electrode materials, low cost and ease of fabrication [1-4]. The aim of this research was to investigate the electrical resistance activation energy of AISI 430 ferritic stainless steel which was coated with Ni-Co-Mn-CeO_2 by electroplating. In this research, AISI 430 ferritic stainless steel was used as the substrate. Electroplating method was used for coating process. In order to measure the area specific resistance (ASR) of the oxidized samples, platinum wires were spot welded to one side of two identical non-oxidized samples to provide electrical connections. A constant current density of $500 mAcm^{-2}$ was applied and the voltage was recorded every 30 minutes. An ammeter and a voltmeter were employed for this purpose. Electrical resistance has been measured as a function of time during annealing at 700 ºC. The Ni-Co-Mn-CeO_2 coating transformed to Mn-Co spinels during isothermal annealing. Results showed the increase of temperature caused to the increase of electrical resistance. The formation of spinel compositions improved electrical resistance activation energy of Ni-Co-Mn -CeO_2 coated substrates (0.0.25 eV) and compared to the uncoated substrates (0.035 eV). The lower electrical resistance activation energy of coated samples resulted to higher electrical conductivity with respect to uncoated ones and this lower value is because of spinel compositions existence on the coated substrates.

Keywords: Solid oxide fuel cell (SOFC), Oxidation, Activation energy, AISI 430 ferritic stainless steel, Interconnect.

References

[1] Avner S 1997 (Second Edition) Introduction to physical metallurgy, McGraw-Hill, New York.
[2] Li L 2003 Materials Letters 57 3444.
[3] Hou K and Chen H 2011 Applied Surface Science 257 6340.
[4] Yongfeng L andLiminZ 2017 Int. J. Electrochem. Sci. 12 3385.

Activation energy of hot corrosion resistance of Ni-Co-Mn-CeO_2 coated AISI 430 steel for SOFC application

Sahar Shakiba [a], Hadi Ebrahimifar [a]* , Mohammad Sefidbakht [b], Saba Dehghgan [c]

[a] Department of Materials Engineering, Faculty of Mechanical and Materials Engineering, Graduate University of Advanced Technology, Kerman, Iran.
[b] Refinery and Foundries factory, Sarchesheme copper complex.
[c] Department of Materials Engineering, Faculty of Engineering, Shahid Chamran University of Ahvaz, Ahvaz, Iran.

** H.Ebrahimifar@kgut.ac.ir*

Abstract

The reduction in the operating temperature of SOFC from 1000 °C to 600–800 °C leads to the potential for using lower cost metallic interconnects materials such as stainless steel. Almost all of the candidate alloys being considered for this application are chromia forming alloys due to the acceptable electrical conductivity and stability of Cr_2O_3. Manganese-cobalt coatings are promising candidates for SOFC interconnect applications because of their high conductivity and good oxidation resistance [1-4]. Coupons of AISI 430 stainless steel, measuring 10 mm × 5 mm × 2 mm were used as substrates. Specimens were polished from 320-grit sic paper up to 1200-grit, ultrasonically cleaned in ethanol and dried. One-compartment cell was used for DC electrodeposition process. Platinum foil was used as anode and was placed in the same compartment of working electrode. During the deposition, the solution was remained unchanged, and no inert gas was used to purge the electrolyte. All experiments were carried out in 100 ml electrolytes prepared with deionized water. The samples were coated with Ni-Co-Mn-CeO_2 by electroplating method. The hot corrosion was done at 800 ºC for 100 hours with a salt mixture consisting of 80 wt.% Na_2SO_4+20 wt.% NaCl (melting point ~700 °C). The samples were also subjected to hot corrosion at different temperatures (700-1000 ºC). Activation energies were calculated 124 and 69 kJ mol^{-1}h for uncoated and Ni-Co-Mn-CeO_2 coated specimens, respectively. The lower activation energy for the Ni-Co-Mn-CeO_2 coated samples would imply that oxide formation is easier during hot corrosion.

Keywords: Hot corrosion, Ni-Co-Mn-CeO_2, Electroplating, Spinel, Activation energy.

References

[1] H. Ebrahimifar, M. Zandrahimi, Surface & Coatings Technology 2011, 206, 75.
[2] N. Shaigan, D. G. Ivey,W. Chen, Journal of the Electrochemical Society 2009, 156, 765.
[3] H. Ebrahimifar, M. Zandrahimi, Oxidation of metals 2015, 84, 129.
[4] C. Lee and J. Bae, Thin Solid Films 2008, 516, 6432.

Investigation of chromia thickness during hot corrosion test for coated Ni-Co-Mn-CeO_2 -AISI 430

Sahar Shakiba [a], Hadi Ebrahimifar [a]* , Mohammad Sefidbakht [b], Saba Dehghgan [c]

[a] Department of Materials Engineering, Faculty of Mechanical and Materials Engineering,
Graduate University of Advanced Technology, Kerman, Iran.
[b] Refinery and Foundries factory, Sarchesheme copper complex.
[c] Department of Materials Engineering, Faculty of Engineering, Shahid Chamran University of Ahvaz, Ahvaz, Iran.

** H.Ebrahimifar@kgut.ac.ir*

Abstract

The formation of oxide scales is one of the critical issues for applying Fe–Cr alloys in solid oxide fuel cells (SOFCs) operated at 773 ºK–1073 ºK (intermediate operation temperature SOFCs) [1-2]. The growth of oxide scale is dominated by the diffusion of elements (cations and oxygen) in the scales and the microstructures of scales [3]. One of the most effective approaches to improve the interconnect properties is to apply surface coatings to provide better conductivity, reduced scale growth and Cr volatility. Ni-Co-Mn-CeO_2 composite coating are promising candidates for SOFC interconnect applications. In the present study, Ni-Co-Mn-CeO_2 composite coating was electrodeposited on AISI 430 ferritic stainless steel. Coated and uncoated samples were subjected to hot corrosion at 800 °C for 100 hours with a salt mixture consisting of 80 wt.% Na_2SO_4+20 wt.% NaCl. The formation of Ni-Mn-Co spinels improves hot corrosion resistance by limiting the inward diffusion destructive ions of oxygen, sulfur and chloride. The chromia thickness was 0.91 µm for uncoated substrates and 3.47 µm for Ni-Co-Mn-CeO_2 -coated substrates after 100 h of hot corrosion at 800 ºC. Hot corrosion resistance of Ni-Co-Mn-CeO_2 coated and uncoated AISI 430 steel was studied at 800 ºC for 100 h. All the coated samples exhibited smaller oxide thickness compared with the bare substrates in all the times.

Keywords: Hot corrosion, AISI 430 steel, Electroplating, Ni-Co-Mn-CeO_2.

References

[1] J.L. Tang, Y. Zuo, , Corros. Sci. 2008, 50, 2873.
[2] W. J. Quadakkers, J. Piron-Abellan, V. Shemet and L. Singheiser, Materials at High Temperatures, 2003, 20, 115.
[3] H. Ebrahimifar, M. Zandrahimi, Oxidation of metals. 2015, 84, 129.

Studying the effect of zeolite on the performance of liquid and gel electrolytic lead-acid batteries

Haniyeh Mortaz[a], Khalil Farhadi[a]*, Mohammad Kazemzadeh[a]

[a]*Department of Analytical Chemistry, Faculty of Chemistry, Urmia University, Urmia, Iran*

**E-mail: Khalil.Farhadi@yahoo.com*
mortaz.ha7@gmail.com

Batteries play an important role in modern society. Lead-acid batteries market is over 70% of rechargeable battery sales [1]. Among them, VRLA (Valve-Regulated Lead-Acid) batteries have become reliable energy storage devices with features like high current capability, good power density, rapid rechargeability and maintenance-free operation [2]. Gel electrolytes in VRLA batteries improve safety by reducing spillage risks, allowing for various orientations, and enhancing durability. Consequently, there is increasing demand for alternative gelling agents for sulfuric acid in the production of gelled-electrolyte (GEL) VRLA batteries [3]. In this research, lead-acid batteries with gel electrolytes were initially produced using sodium silicate or silica foam at concentrations of 3%, 4%, 5%, and 6% (w/w%) as gelling agents, along with commercial paste electrodes (positive and negative) obtained from a battery manufacturer. Additionaly, 0.005%, 0.05%, 0.1% and 0.5% (w/v) of zeolite were added to study the gel formation time. To investigate the electrochemical behavior of the electrolytes, a three-electrode system comprising a lead working electrode and a platinum counter electrode was employed and the results were studied using cyclic voltammetry (CV) and chronopotentiometry (CHP). Results showed that the main oxidation-reduction peaks at 0.5 and 1 V, corresponding to the half-reactions Pb/$PbSO_4$ and $PbSO_4$/PbO_2, remained unchanged, indicating that fumed silica is stable under the operational conditions of lead-acid batteries and doesn't involve any additional reactions which makes fumed silica superior to sodium silicate, resulting in a more stable gel state and the addition of zeolite significantly reduced the gel formation time by up to 4 hours.

Keyword: Gel batteries, Zeolite, Cyclic voltammetry, lead acid batteries

References

[1] S. Jiang, Z. Song, A review on the state of health estimation methods of lead-acid batteries, Journal of Power Sources, 517 (2022) 230710.

[2] D.W. Lambert, P.H. Greenwood, M.C. Reed, Advances in gelled-electrolyte technology for valve-regulated lead-acid batteries, Journal of power sources, 107 (2002) 173-179.

[3] D. Pavlov, Lead-acid batteries: science and technology, Elsevier2011.

Electrochemical oxidation and docking simulation of catechol in the presence of clobazam

Zahra Godini,[a] **Davood Nematollahi**[*a,b]

[a]*Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran*

[b]*Planet Chemistry Research Center, Bu-Ali Sina University, Hamedan, Iran*
[*]*E-mail: godini.zahra97@gmail.com*

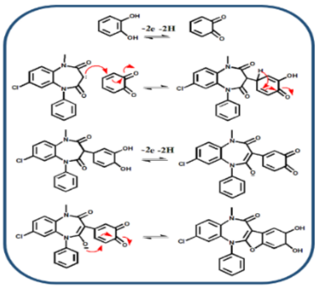
Abstract: The electrochemical oxidation of catechol was studied in the presence of clobazam (**CBZ**) as a nucleophile. Catechol can be electrochemically oxidized to *o*-benzoquinone. *o*-Benzoquinone is a very reactive compound and can react with nucleophiles to form various organic compounds [1].

Background:

CBZ is a benzodiazepine derivative that is used to treat epilepsy. Catechol derivatives play an important role in mammalian metabolism, and in addition, many drugs contain a catechol substrate [2]. For this reason, we are looking for a new structure based on catechol and **CBZ** with medicinal properties.

Results:

Catechol is oxidized and converted to o-benzoquinone. The electrochemically produced benzoquinone was reacted with CBZ as a CH acid nucleophile and is converted into the final product through inter and intramolecular Michael addition reactions (ECEC mechanism) (Scheme1). According to docking studies, the synthesized structure as a ligand has a good interaction with the GABA receptor (Figure 1). The synthesized structure interacts well with the GABA receptor due to having a suitable binding affinity (less than minus 5).



Scheme 1. Proposed mechanism for the electrochemical oxidation of catechol in the presence of **CBZ**.

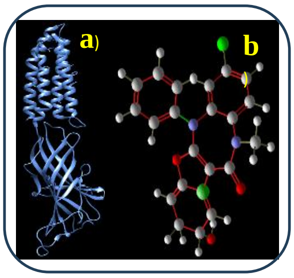


Figure 1. a) Secondary structure of GABAA-receptor (PDB ID: 5osc) b) Synthesized structure

Significance:

Electrochemical methods are very useful for studying electroactive drugs due to their unique features. Considering the importance of designing new drugs, in this research we are trying to create a new drug structure with favorable results.

Keywords: Electrochemical methods, Michael addition reaction, Clobazam, Catechol.

References

[1] D. Nematollahi, M. Rafiee, and H.R. Khavasi, *Bulletin of the Chemical Society of Japan*, 81(2008)1505
[2] M. Ardakani, A. Khoshroo, D. Nematollahi and B.F. Mirjalili, *Journal of The Electrochemical Society*, 159 (2012)912.

Combination of three-phase hollow fiber microextraction method and solid phase microextraction for extraction and electrochemical measurement of glucose

Zahra Arabi[1], Jahan Bakhsh Raoof[1]*, Milad Ghani[2]

[1]*Electroanalytical Chemistry Research Laboratory, Department of Analytical Chemistry, Faculty of Chemistry, University of Mazandaran, Babolsar, Iran.*

[2]*Department of Analytical Chemistry, Faculty of Chemistry, University of Mazandaran, Babolsar, Iran.*

E-mail: zahraarabi7500@gmail.com

Abstract

Due to the necessity of measuring glucose as the main fuel of the body in biological samples [1], it is necessary to prepare the sample containing the test analyte, concentrate the desired test species and extract it from other containing of sample [2]. Various extraction methods have been developed to prepare samples before separation and measurement. In this regard, three-phase liquid microextraction methods with hollow fiber using a small amount of organic solvent provide a high contact surface [3]. Also, electrochemical sensors have received more attention than other analytical methods. Among their advantages, we can mention sensitivity, accuracy and speed in measurement [4].

Here, the glucose was separated and preconcentration by using a simple extraction cell including porous fiber three-phase microextraction method and it measured with differential pulse voltammetry (DPV) method at surface of poly (1- naphthylamine)/ Ni (II)/ pencil graphite electrode. Therefore, combining of porous fiber three- phase microextraction with DPV showed linear dynamic range (4.0×10^{-5} – 8.0×10^{-3} µM and 4.0×10^{-2} – 8.0 µM) with detection limit (LOD) 1.41×10^{-5} µM in optimal conditions.

The electrochemical sensor exhibits excellent electrochemical performance, low LOD, wide LDR, high stability for non- invasive glucose measurement. In addition, the proposed method has shown a good recovery percentage (92-111) with optimal accuracy and precision for non- invasive measurement of glucose in different blood plasma samples of healthy and diabetic people.

Keywords: Three-phase hollow fiber, Differential pulse voltammetry, Glucose electro-oxidation, Blood plasma.

References

[1] A. M. Shendurse & C. D. Khedkar, Glucose: properties and analysis. *Encyclopedia of Food and Health*, *3* (2016) 239-247.

[2] S. A. Barker, A. R. Long, & C. R. Short, Isolation of drug residues from tissues by solid phase dispersion. *Journal of Chromatography A*, **475**(2), (1989) 353-361.

[3] S. Pedersen-Bjergaard & K. E. Rasmussen, Liquid-phase microextraction with porous hollow fibers, a miniaturized and highly flexible format for liquid–liquid extraction. *Journal of Chromatography A*, **1184**(1-2) (2008) 132-142.

[4] X. Niu, X. Li, J. Pan,Y. He, F. Qiu, & Y.Yan. Recent advances in non-enzymatic electrochemical glucose sensors based on non-precious transition metal materials: opportunities and challenges. *RSC Advances*, *6*(88) (2016) 84893-84905.

Investigating the effectiveness of a TiO2-NTs/SnO2-Sb2O5-NiO modified electrode in removing dispersed Red 73 dye from water solutions and textile industry wastewater

Soudabeh Dalirnasab, **Ali Benvidi***

Department of Chemistry, Yazd University, Yazd, Iran, Fax: 03538210644; Tel: 035 31232645
E-mail: benvidi89@gmail.com, abenvidi@yazd.ac.ir, s.dalirnasab@gmail.com

Abstract

Water is a crucial resource globally, serving as the foundation for production processes in many industries. Its quality and availability can significantly impact production outcomes. For instance, the textile industry relies heavily on water for washing, dyeing, bleaching, and other processes, leading to high water consumption. Treating dye-laden wastewater is a pressing environmental issue. Ozone, with an oxidation potential of 2.07 V, is an effective and safer oxidizing agent for advanced water treatment processes, as it quickly decomposes into oxygen without leaving harmful residues. This study aims to explore the treatment of textile wastewater containing dispersed Red 73 dye using electrochemical ozone generation with a titanium anode electrode modified with nickel, antimony, and tin oxides. The findings revealed that the modified electrode could degrade 97.1% of dispersed Red 73 dye from an initial concentration of 100 $mg \cdot L^{-1}$ within 130 minutes at a current density of 25 $mA \cdot cm^{-2}$. Additionally, the chemical oxygen demand (COD) removal was measured at 58.4% during 60 minutes of electrolysis.

Keywords: Wastewater, Dispersed Red 73, Chemical oxygen demand

References

[1] S. Shokrollahzadeh, M. Abassi, M. Ranjbar, Environ. Eng. Res, 24 (2018) 513-520.
[2] M. Revathi, B. Kavitha, C. Vidhi, J. Environ. Sci. Heal. C. 37 (2019) 42-54.
[3] N.Supaka, K. Juntongjin, S. Damronglerd, Chem. Eng.J. 99 (2004) 169-176.

Electrochemical ozone production using a $TiH_X/Sb\text{-}SnO_2\text{-}Ni$ electrode and its effective application in breaking down dyes from textile wastewater

Soudabeh Dalirnasab, **Ali Benvidi***

Department of Chemistry, Yazd University, Yazd, Iran, Fax: 03538210644; Tel: 035 31232645
E-mail: benvidi89@gmail.com, abenvidi@yazd.ac.ir, s.dalirnasab@gmail.com

Abstract

Textile wastewater is a significant environmental pollutant, containing various dyes, chemicals, and salts. One effective method for removing these contaminants is through the use of oxidation agents like ozone (O_3). Ozone is an eco-friendly oxidizing agent commonly used in wastewater purification, water disinfection, and the decomposition of organic materials. This research focuses on developing an electrode that is efficient, stable, and easy to manufacture, specifically for generating ozone through electrochemical methods. To enhance the stability of the titanium-based $Ni\text{-}Sb\text{-}SnO_2$ anode, a titanium hydride interlayer (TiH_X) is created. This interlayer acts as a binding agent, connecting the TiO_2 and $Ni\text{-}Sb\text{-}SnO_2$ phases. The standard indigo method was used to assess ozone generation on the electrode's surface. Parameters such as repetition coating time, current density, and electrolyte concentration were optimized to 18, 15 mA cm-2, and 0.1 M HClO4, respectively. Using UV-Vis spectroscopy, the concentration of soluble ozone was found to be 9.28 mg L^{-1}. experimental results showed that the modified electrode could degrade 96% of cationic yellow 28 dye from an initial concentration of 100 mg L^{-1} within 130 minutes at a current density of 20 mA cm^{-2}. Additionally, the chemical oxygen demand (COD) removal was measured at 53.6% during 60 minutes of electrolysis.

Keywords: Environmental pollutant, Ozone, Titanium hydride interlayer, cationic yellow 28

References

[1] R. Zhang, D-X. Yuan, B-M. Liu, *Chinese Chem. Lett*, 35 (2015) 93-99.
[2] M. Revathi, B. Kavitha, C. Vidhi, J. Environ. Sci. Heal. C, 37 (2019) 42-54.
[3] H. Shekarchizade, M.K. Amini, Int. J. Electrochem, 34 (2011) 149.
[4] S. Shokrollahzadeh, M. Abassi, M. Ranjbar, Environ. Eng. Res, 24 (2018) 513-520.

Adulterations detection and evaluation of some qualitative characters of apple concentrate using electrochemical impedance spectroscopy (EIS)

Elham Sharifi[a], Khalil Farhadi[a]*, Mohammad Kazemzadeh[a]

[a]*Department of Analytical Chemistry, Faculty of Chemistry, Urmia University, Urmia, Iran*

**E-mail:Khalil.farhadi@gmail.com*
Mohammadkazemzadeh6457@gmail.com

Given the increasing global demand for food, the use of adulterated food products such as dilution with water, the use of sweeteners like sucrose, saccharin, aspartame and the addition of acidifying agents has become a significant concern [1]. The growing demand for apple juice observed in the market serves as a strong incentive for producers and fraudulent products seeking quick profits by concealing poor quality composition. To limit such practices, food control agencies are responsible for monitoring consumer safety [2]. Various methods, such as HPLC, GC and potentiometry, have been used to detect these adulterations [3]. However, using a rapid method without sample preparation would be interesting. Due to the presence of various organic and inorganic substances such as sugars, anions and cations in apple concentrate and their different behaviors in aqueous solutions, this work introduces a method based on electrochemical impedance spectroscopy (EIS) as a conventional, non-destructive and reliable method to detect possible adulterations. In this regards, based on the behaviors of adulterate agent, EIS can provide interesting information. An electrochemical cell using two and three platinum electrodes was used to study the impact of various sugars on EIS of apple concentrate. Results showed that the solution resistance (Rs) of palm sugar is 639 Ω.cm² and the Rs of pure apple concentrate is 2448 Ω.cm². The Rs of the adulterated sample, depending on its concentration, falls between 639-2448 Ω.cm². Overall, electrochemical techniques, particularly EIS, offer a promising method for detecting adulterate agents in the food sector.

Keyword: Adulteration, Apple concentrate, Electrochemical impedance spectroscopy

References

[1] P. Thavarajah, N.H. Low, Adulteration of apple with pear juice: emphasis on major carbohydrates, proline, and arbutin, Journal of Agricultural and Food Chemistry, 54 (2006) 4861-4867.

[2] J.K. Banach, R. Żywica, A method of evaluating apple juice adulteration with sucrose based on its electrical properties and RCC model, Sustainability, 13 (2021) 6716.

[3] M. Vanoli, M. Buccheri, Overview of the methods for assessing harvest maturity, (2012).

Ternary $FeNiS_2$ Nanocomposites Tip-Welded on Nickel Foam for Electrocatalytic Oxygen Evolution Reaction

Hamideh Imanzadeh[a], **Alireza Khataee**[a]*, **Mandana Amiri**[b]

[a]*Research Laboratory of Advanced Water and Wastewater Treatment Processes, Department of Applied Chemistry, Faculty of Chemistry, University of Tabriz, 51666−16471 Tabriz, Iran*

[b]*Department of Chemistry, University of Mohaghegh Ardabili, 56199-13131 Ardabil, Iran*

**E-mail: Hamidehimanzadeh3@gmail.com*

Abstract

Hydrogen is considered a promising clean energy carrier due to its zero carbon emissions and high energy density [1]. Electrochemical water splitting, which can be paired with intermittent energy sources like solar, wind, and tidal power, is seen as a key technology for generating green hydrogen. However, the slow kinetics of the anodic oxygen evolution reaction (OER) poses a significant challenge to enhancing hydrogen production efficiency. As a result, many catalysts have been developed for the OER to improve reaction rates and lower the required overpotential [2]. In this study, a binary metallic FeNi metal-organic framework (MOF) was synthesized through a unique method termed reductive electrosynthesis. This MOF provided tailored catalytic sites within a highly porous material by attaching metal cations through linkers. However, pristine MOFs have been limited application due to poor electrical conductivity and stability. hence, we designed ultrathin $FeNiS_2$/Nickel Foam (NF) nanocomposites derived from self-sacrificial FeNi-MOF template and precursor. During the electrochemical oxygen evolution reaction (OER) process, this cutting-edge $FeNiS_2$/NF nanocomposite demonstrated remarkable stability, a desired tafel slope, and a lower overpotential. As a result, the outstanding functional electrocatalytic performance of $FeNiS_2$/NF on OER in alkaline media was observed at low overpotential of 280 mV at 10 mA $cm^{-2}$and a tafel slope of 35 mV/dec.

References

[1] Lin, Lin, et al. "Non-Ir based catalyst for the electrocatalytic oxygen evolution reaction: progress and challenge." Journal of Materials Chemistry A (2024).
[2] Cheng, Wenjing, et al. "Modulation of the electronic structure of CoP by surface and interface codoping boosts electrocatalytic oxygen evolution reaction." International Journal of Hydrogen Energy 51 (2024): 914-921.

A label-free paper-based electrochemical immunosensor for Exosome detection via mesoporous carbon nanofoam

Nafiseh Sahraei[a]*, **Mohammad Mazloum Ardakani**[b]
[a]*Department of Medicinal Chemistry, Faculty of Pharmacy, Shahid Sadoughi University of Medical Sciences, Yazd, Iran*
[b]*Department of chemistry, Faculty of Science, Yazd University, Yazd, Iran*
**E-mail:* naf.sahraei@gmail.com

Abstract

Point-of-care testing (POCT) involves a wide range of diagnostic tools that meet this purpose. Electrochemical paper-based devices (ePADs) have been introduced as simple, inexpensive, portable and disposable measurement devices to be used in many POCT applications, especially in handling emergencies and outpatient as well as remote usages [1]. Electrochemical detection is a real quantitative detection method with better sensitivity, selectivity and detection limits than indirect measurement methods [2].

In the current study, a cost-effective, biodegradable electrochemical device based on a highly flexible chromatographic paper was fabricated. This electrochemical immunosensor based on a sensitive paper without label was successfully designed for detection of exosomes extracted from MCF-7 cell line. So, due to the advantages of each material used in the nano composite individually containing Hemin molecule, carbon nanofoam and multiwall carbon nanotubes (Hem, MCF and MWCNT) higher electric currents was created and led to construction of a new electrochemical sensor. The absorbed Hemin in MCF not only acts as a protective factor for it, but also acts as an excellent probe and no need to use an external probe in the sensor (label free). Some advantages of the paper based electrodes are: easy application, not expensive, high sensitivity and selectivity. Some effective parameters on the biosensor performance were optimized. Under the optimum conditions, the proposed label-free immunosensor used for analysis of biological samples (exosomes) in a linear range of $5 \times 10^2 – 5 \times 10^5$ exosome/μL and a detection limit of 150 exosome/μL.

Keywords: Exosome, Paper-based electrochemical immunosensor, Label free, Hemin molecule, Mesoporous carbon nanofoam

References

[1] B.G. Rosa, O.E. Akingbade, X. Guo, L. Gonzalez-Macia, M.A. Crone, L.P. Cameron, P. Freemont, K.-L. Choy, F. Güder, E. Yeatman, *Journal of Biosensors and Bioelectronics*, 203 (2022) 114050.

[2] N.Sahraei, M.Mazluom-Ardakani, A. Khoshroo, F.Hoseynidokht, J. Mohiti, A. Moradi, *Journal of Electroanalytical Chemistry*, 920 (2022) 116590.

Conductive Microneedles Supported Biological Metal-Organic Frameworks Toward Electrochemical Detection of β-Hydroxybutyrate Biomarker

Fereshteh Amourizi[a*], **Kheibar Dashtian**[a], **Rouholah Zare Dorabei**[a]

[a]*Department of Chemistry, Iran University of Science and Technology, Tehran, Iran*

[*]*E-mail: fereshtehamourizi@gmail.com*

Abstract:

Background:

The demand for non-invasive and real-time metabolic monitoring has driven the development of advanced biosensors. β-Hydroxybutyrate (BHB), a vital biomolecule for ketosis, requires accurate detection for effective management of metabolic disorders [1]. This study addresses the challenge of developing a minimally invasive, highly sensitive biosensor for BHB detection using conductive microneedles (CMNs) supported a molecularly imprinted polymers (MIPs) coated biological Zn based metal-organic frameworks (Zn-MOFs) [2, 3].

Results:

The electrochemical analysis demonstrated that the sensor exhibited a broad linear range (0.1 to 5.0 mM), a low detection limit of 0.05 mM, and high specificity towards BHB, even in the presence of common interferents. The microneedle array was able to penetrate the skin for several times with minimal discomfort, allowing direct sampling from interstitial fluid and real-time monitoring.

Significance:

This study presents a significant advancement in wearable biosensor technology by integrating MIP-functionalized Zn-MOFs with conductive microneedles [4]. The developed biosensor provides a non-invasive, accurate, and real-time method for monitoring BHB levels, offering potential applications in managing diabetes and optimizing ketogenic diets. The findings underscore the potential of this technology to improve patient outcomes and advance the field of metabolic monitoring [5].

Keywords: Conductive microneedle, Electrochemical biosensor, β-Hydroxybutyrate biomarker

References

1. Shen, Y., et al., *Wearable microfluidic electrochemical sensor integrated with iontophoresis for non-invasive sweat ketone monitoring.* Sensors and Actuators B: Chemical, 2024: p. 136518.
2. Vora, L.K., et al., *Microneedle-based biosensing.* Nature Reviews Bioengineering, 2024. **2**(1): p. 64-81.
3. Li, Y., et al., *Recent advances in molecularly imprinted polymer-based electrochemical sensors.* Biosensors and Bioelectronics, 2024: p. 116018.
4. Liu, K., et al., *Lab on the Microneedles: A Wearable Metal–organic Frameworks-Based Sensor for Visual Monitoring of Stress Hormone.* ACS nano, 2024.
5. Wang, Q., et al., *Wearable Vertical Graphene-Based Microneedle Biosensor for Real-Time Ketogenic Diet Management.* Analytical Chemistry, 2024.

Highly sensitive electrochemical detection of aquaporin-4 antibody by Nickel- Metal organic framework (Ni-MOF)/CNT

Farzaneh Hoseynidokht[a], Mohammad Mazloum-Ardakani[a*] , Nafiseh Sahraei[a]

[a]*Department of Chemistry, Faculty of Science, Yazd University, Yazd 89195-741, Iran*

*E-mail: *f.hoseynidokht@gmail.com*

Abstract

Neuromyelitis optica (NMO) is an autoimmune disease that causes disorders in the central nervous system. Aquaporin-4 antibodies (AQP4-Ab) are a specific and sensitive serum marker for NMO, distinguishing it from classic multiple sclerosis [1]. Here, we present a fast and simple method for the detection of aquaporin-4 biomarkers. In this regard, a new electrochemical material has been developed, which is nickel-metal organic framework/carbon nanotube (Ni-MOF/CNT). Metal-organic frameworks (MOFs) are crystalline materials, and when combined with carbon nanotubes, they significantly reduce MOF defects while enhancing conductivity and electron/ion transport capacity [2, 3]. Also, a novel and highly selective biosensor was developed on an electrode surface for the ultrasensitive detection of aquaporin-4 through of functionalized glassy carbon electrode (GCE) with the Ni-MOF/CNT as an efficient nanocomposite. In the proposed sensing strategy, the antigen can undergo π-π interaction with the Ni-MOF/CNT nanocomposites, which were attached to the surface of a modified GCE. By combining the advantages of each nanocomposite component, such as the porosity and high surface area of Ni-MOF and the excellent conductivity of CNT, the synthesized nanocomposite exhibited strong electrocatalytic activity on the electrode surface. The electrochemical measurements were investigated using cyclic voltammetry (CV) and the EIS technique. The designed biosensor showed a low detection limit of 6.2 pg/mL. Consequently, biosensors based on the synthesized nanocomposite demonstrated highly favorable sensing performance, including desirable operating potential, high stability, sensitivity, and reproducibility.

Keywords: electrochemical biosensor, neuromyelitis optica, Ni-MOF/CNT nanocomposite.

References

[1] S. Jarius and B. Wildemann, *Brain Pathol.*, 23 (2013) 661
[2] A. E. Thorarinsdottir and T. D. Harris, *Chem. Rev.*, 120 (2020) 8716.
[3] M. V Varsha and G. Nageswaran, *J. Electrochem. Soc.*, 167 (2020) 155527.

Ultrasensitive Immunosensor for detection of aquaporin-4 antibody by porous graphene aerogel matrix incorporated with ytterbium oxide nanoparticles

Farzaneh Hoseynidokht[a], **Mohammad Mazloum-Ardakani**[a*], **Fatemeh Farbod**[a]

[a]*Department of Chemistry, Faculty of Science, Yazd University, Yazd 89195-741, Iran*

[*]*E-mail: f.hoseynidokht@gmail.com*

Abstract

Interconnected graphene aerogels and their composites with transition metal oxide nanoparticles are attracting increasing research interest in the fabrication of immunosensors.

Graphene aerogel (GA), is highly porous. Its high specific surface area offers many active sites for catalytic reduction processes, and its large pore volume causes rapid mass transfer of redox species [1]. Therefore they can be a suitable platform for the placement of other nanoparticles.

Increasing selectivity and surface protection from unwanted reactions is one of the reasons for modifying electrodes. So it is possible to accurately measure chemical species on the surface of the electrode modified with nanomaterials [2].

Neuromyelitis optica (NMO) is a severe neurodegenerative disorder of the central nervous system. Antibodies to aquaporin-4 constitute a specific serum marker of NMO. Therefore, detecting AQP4 antibodies can be helpful in precisely diagnosing NMO, which shares similar symptoms with other diseases such as multiple sclerosis and other CNS idiopathic inflammatory disorders [3].

In this work, reduced graphene aerogel decorated with ytterbium oxide nanoparticles was prepared via a simple one-step hydrothermal method. Then was employed as an excellent substrate for hosting antigens. The synthesized nanocomposite exhibited very well electrocatalytic activity on the electrode surface. The electrochemical measurements were investigated using cyclic voltammetry (CV) and EIS technique. The designed biosensor showed a linear range from 0.01 ng mL^{-1} to 10 ng mL^{-1}. Hence, this new Immunosensor can have a reliable potential application in aquaporin-4 antibodies detection

Keywords: immunosensor, c, autoimmune diseases,

References

[1] M. Sun, B. Ding, J. Yu, Y.L. Hsieh, G. Sun, *Sensor. Actuator. B Chem*., 161 (2012) 328.
[2] R. Li, T. Yang, Z. Li, Z. Gu, G. Wang, J. Liu, *Anal. Chim. Acta*., 954 (2017) 43.
[3] M. Apiwattanakul, T. Asawavichienjinda, , E. S. Horta, S. M. Jenkins and S. J. Pittock, *J. Neurol. Sci.*, 320 (2012) 118.

Effect of bias voltage on the photo-activity of bismuth vanadate mesoporous layers

<u>Mina-Sadat Koshki</u>[a], Sahra Khosrojerdi[a], Mehdi Baghayeri[a,*], Sirous Salemi[a], Mohammad Zirak[b]
[a]*Department of Chemistry, Faculty of Science, Hakim Sabzevari University, Sabzevar, Islamic Republic of Iran*
[b]*Department of Physics, Faculty of Science, Hakim Sabzevari University, Sabzevar, Islamic Republic of Iran*
[*]*E-mail: m.baghayeri@hsu.ac.ir (Mehdi Baghayeri)*

Background:

Bismuth vanadate ($BiVO_4$), having unique properties such as high chemical stability, low cost and simple fabrication and compatibility with the environment, has received wide attention for photocatalytic and photoelectrochemistry applications. However, poor charge transfer properties, low mobility of charge carriers and high recombination rate of photoelectrons limit its overall efficiency. Therefore, several strategies have been adopted to improve the performance of $BiVO_4$ [1,2].

In the present work, the ITO/$BiVO_4$ photoelectrode was first prepared by hot spin method (HSC), and then the effect of changing the bias potential as one of the experimental parameters affecting the performance of the $BiVO_4$ photoelectrode was investigated.

Experimental section

Fabrication of ITO/$BiVO_4$ thin film

ITO/$BiVO_4$ mesoporous thin film photoelectrode was fabricated according to our previous work [3]. Finally, the fabricated electrode was used for photoelectrochemical (PEC) investigations.

Results

The effect of bias voltage applied as an experimental parameter on the PEC efficiency of ITO/$BiVO_4$ in Na_2SO_4 was studied. As seen in Figure 1, the photocurrent density increases with increasing potential towards more positive potentials and reaches maximum value at + 0.2V. Then, with the further increases of the potential, it goes through a downward trend. Therefore, the potential of + 0.2 V was chosen as the optimal potential.

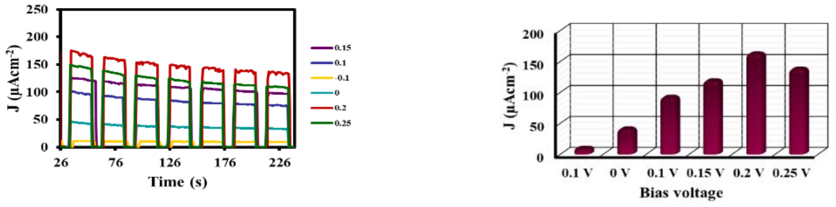


Figure 1. The effect of bias voltage on photocurrent responses of fabricated ITO/$BiVO_4$ electrode. (A) Chronoamperometric curve (j-t), (B) Column chart.

Keywords: Photoelectrochemical (PEC), Bismuth vanadate ($BiVO_4$), Thin film

References

[1]Tan HL, Amal R, Ng YH. Alternative strategies in improving the photocatalytic and photoelectrochemical activities of visible light-driven BiVO 4: a review, Journal of Materials Chemistry A, 5(32) (2017) 16498-521.
[2]Chen L, Chen Y, Miao L, Gao Y, Di J. Photocurrent switching effect on BiVO4 electrodes and its application in development of photoelectrochemical glucose sensor, Journal of Solid State Electrochemistry, 24(2) (2020) 411-20.
[3]Kazemi M, Zirak M, Alehdaghi H, Baghayeri M, Nodehi M, Baedi J, et al. Toward preparation of large scale and uniform mesoporous BiVO4 thin films with enhanced photostability for solar water splitting, Journal of Alloys and Compounds, 969 (2023) 172409.

Development of a novel and highly sensitive electrochemical sensor based on FeCu-LDH@MXene nanocomposite for the selective determination of clonazepam

Saeedeh Shahparast[a], **Karim Asadpour-Zeynali** [b*]

[a]*Department of Analytical Chemistry, Faculty of Chemistry, University of Tabriz, Tabriz, Iran*

[b]*Department of Analytical Chemistry, Faculty of Chemistry, University of Tabriz, Tabriz, Iran*

[*]*E-mail:* asadpour@tabrizu.ac.ir

Clonazepam (CLZP) is a benzodiazepine medication that has various properties such as anxiolytic, muscle relaxant, hypnotic, and sedative. It is used in clinical settings to prevent seizures and control epilepsy [1, 2]. A simple, fast, and sensitive method for determining CLZP concentrations is needed for successful clinical treatment, as excessive consumption can increase seizures frequency [3]. The present work introduces a novel, unique, and very sensitive sensor for clonazepam measuring based on modifying a glassy carbon electrode with FeCu-LDH@MXene nanocomposite. The composition and morphology of FeCu-LDH@MXene nanocomposite was examined by scanner electron microscopy (FESEM), transmission electron microscope (TEM), element mapping (MAP), Fourier transform infrared (FTIR), energy-dispersive X-ray spectroscopy (EDX), X-ray photoelectron diffraction (XRD), and Raman techniques. The suggested sensor shows excellent electrocatalytic activity for clonazepam reduction. Using the DPV technique in ideal conditions, the calibration curve for clonazepam was plotted. The linear range of 0.66–418 μM and detection limit of 90 nM were obtained for clonazepam reduction. The results demonstrate that the designed sensor has excellent repeatability, reproducibility, and stability in the measurement of clonazepam. The fabricated sensor was also effectively used for the measurement of clonazepam in human plasma and pharmaceutical tablet samples.

Keywords: Electrochemical sensor, FeCu-LDH@MXene/GCE, determination of clonazepam, differential pulse voltammetry, human plasma.

References

[1] F. Al-Otaibi, *Journal of Pharmacy and Bioallied Sciences* 14 (2022) 126–131.
[2] A.N. Edinoff, C.A. Nix, A.S. Odisho, C.P. Babin, A.G. Derouen, S.C. Lutfallah, E.M. Cornett, K.S. Murnane, A.M. Kaye, A.D. Kaye, *Neurology International* 14 (2022) 648–663.
[3] W. Li, Y. Liu, H. Jiang, J. Du, Y. Zhao, Z. Du, S. Li, H. Wang, *Front. Psychiatry* 13 (2022) 831276.

The performance of polydiphenylamine synthesized by an ultrasonication approach as a precursor in electrochemical supercapacitors

Zahra shams ghamsari[a], **Hani sayahi**[a*]

[a] *Chemistry and Chemical Engineering Research Center of Iran, Tehran, Iran*
E-mail: Sayahi@ccerci.ac.ir

Abstract

Background:

Nowadays, to reduce environmental pollution, the use of eco-friendly energy storage devices, including electrochemical supercapacitors, has received much attention [1]. In carbon-based supercapacitors that have a higher surface area, an electric double layer is created and this mechanism is used to store charges. Differently, in polymer-based supercapacitors, the pseudo-capacitance mechanism is dominant due to redox reactions and electron transfer [2]. Conductive polymers are widely used in the field of supercapacitors due to their high flexibility and specific capacitance. Polydiphenylamine, an organic conductive polymer, has been studied recently for use as a precursor in supercapacitor electrodes because of its high solubility in most organic solvents and good thermal stability. In the present study, the chemical synthesis of polydiphenylamine was carried out via an ultrasonication approach. Then it was drop cast on a graphite substrate and used as a supercapacitor electrode [3].

Results:

The as-prepared polydiphenylamine was characterized using XRD, FESEM, and FTIR techniques. The electrode's electrochemical properties were analyzed through cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS), and galvanostatic charge-discharge (GCD) studies. The specific capacitance of polydiphenylamine using CV and GCD curves was found to be 105.9 F/g at 25 mV/s scan rate and 213.9 F/g at 1A/g current density, respectively.

Significance:

The fabricated electrode showed good capacitive performance due to its electric double-layer and pseudo-capacitive mechanisms and also the synergistic effects caused by the polymer's bonding to the graphite surface.

Keywords: Polydiphenylamine, Electrochemical supercapacitors, graphite sheet.

References

1. Wang G, Zhang L, Zhang J. A review of electrode materials for electrochemical supercapacitors. Chem. Soc. Rev. 2012;41:797–828.

2. Gautham Prasad G, Shetty N, Thakur S, Rakshitha, Bommegowda KB. Supercapacitor technology and its applications: A review. IOP Conf. Ser. Mater. Sci. Eng. 2019;561.

3. Veni Keertheeswari N, Madaswamy SL, Chokkiah B, Albaqami MD, Wabaidur SM, Lee SC, et al. Synthesis of polydiphenylamine nanostructures via microwave and ultra-sonication method for supercapacitor performance. J. Mater. Sci. Mater. Electron. 2022;33:23236–49.

in situ co-electropolymerization of resorcinol/o-phenylene diamine on silver nanoparticle loaded multiwalled carbon nanotube for accurate detection of regorafenib

Neda Zalpour[a], Mahmoud Roushani[b]*, Essra khamis abdollah[c]
[a,b,c]*Department of Chemistry, Faculty of Science, Ilam University, Ilam, Iran*

E-mail: Nedazalpour@yahoo.com

Abstract:

Background: This study aims to develop an electrochemical sensor using the molecularly imprinted polymer (MIP) technique by modifying the glassy carbon electrode (GCE) with silver loaded carboxylated multiwalled carbon nanotube (Ag-cMWCNT) nanoparticles as a sublayer. Sensor designed to detect regorafenib (REG) with high sensitivity and selectivity [1-5].

Work: Resorcinol (Res) and ortho phenylene diamine (O-PhDA) was used as functional monomers. In situ co-electro polymerization performed in solution of PBS 0.1M (pH = 7) containing 0.1M KCl, 5 mM O-PhDA, 5 mM Res, and 3 mM REG by application of 40 cycles within the potential range of -0.2 to 0.8 V, with a scan rate of 0.05 $V.s^{-1}$. The mixture of DMF, Et-OH, and HNO_3 in a 1:1:3 ratio at an optimized time 25 min was used as extracting solvent. FESEM. EDS, AFM and FTIR analysis were used to verify the accuracy of the proposed sensor synthesis. The designed sensor easily measured REG with high accuracy and repeatability solving the problem of requiring expensive laboratory equipment.

Results: The MIP sensor exhibited two linear relationships throughout the concentration range of 0.00005 to 0.004 μM and 0.006 to 0.05 μM with $I_{(\mu A)} = 3300.4[REG] + 13.759$ and $I_{(\mu A)} = 195.79[REG] + 29.19$ equations and correlation coefficient (R^2) values of $R^2 = 0.9252$ and $R^2 = 0.9519$ respectively. The detection limit was determined to be 0.006 nM. The imprinting factor was calculated as 9.36.

Significance: The sensor's performance in biological fluids such as blood serum was investigated, and significant results were obtained.

Keywords: Regorafenib, Molecularly imprinted polymer, in situ co-electropolymerization

References

[1] A.E.F. Oliveira, A.C. Pereira, L.F. Ferreira, Disposable electropolymerized molecularly imprinted electrochemical sensor for determination of breast cancer biomarker CA 15-3 in human serum samples, Talanta. 252 (2023) 123819.

[2] T.M.B.F. Oliveira, S. Morais, New generation of electrochemical sensors based on multi-walled carbon nanotubes, Appl. Sci. 8 (2018) 1925.

[3] K. Köse, D.Y. Kehribar, L. Uzun, Molecularly imprinted polymers in toxicology: A literature survey for the last 5 years, Environ. Sci. Pollut. Res. 28 (2021) 35437–35471.

[4] M.A. Beluomini, J.L. da Silva, A.C. de Sá, E. Buffon, T.C. Pereira, N.R. Stradiotto, Electrochemical sensors based on molecularly imprinted polymer on nanostructured carbon materials: A review, J. Electroanal. Chem. 840 (2019) 343–366.

[5] L. Wang, M. Pagett, W. Zhang, Molecularly imprinted polymer (MIP) based electrochemical sensors and their recent advances in health applications, Sensors and Actuators Reports. 5 (2023) 100153.

hydroxybenzothiazole. A flow cell with a new design to improve the yield and purity

Sajad Shanesaz,[a] **Vahid Asgari,**[b] **Davood Nematollahi,**[a,c*] **Yaser Saebi,**[d] **Armin Sadeghinia,**[a]

[a]*Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran*
[b]*Faculty of Engineering, Bu-Ali Sina University, Hamedan, Iran*
[c]*Planet Chemistry Research Center, Bu-Ali Sina University, Hamedan, Iran.*
[d]*School of Chemistry, College of Science, University of Tehran, Tehran, Iran*
*E-mail: sajad.shanesaz.hmd@gmail.com

Abstract: An efficient electrochemical synthesis of 2-amino-6-hydroxybenzothiazole, starting from hydroquinone and thiourea is described. This compound was synthesized with excellent yield without toxic reagents and solvents using an environmentally friendly method. We report here the synthesis of this compound in a batch cell and a new designed flow cell under constant current conditions.

Since 2-aminobenzothiazole scaffolds are found in many biologically active compounds and natural products, many attempts have been reported to synthesize them [1]. We report herein a green and facile electrochemical synthesis of 2-aminobenzothiazole (Figure1) under metal-free conditions starting from readily available hydroquinone and thiourea.

The voltammetric results of hydroquinone in the presence of thiourea show that the quinone resulting from the oxidation of hydroquinone reacts with thiourea and becomes the final product after inter and intra-cyclization reactions. In this project, a new tubular flow cell was designed in which graphite rods act as anodes and stainless steel or copper tubes act as cathodes. In this cell, with the changes made on the surface of the graphite rod, the mass transfer increases, which increases the synthesis yield.

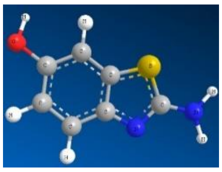


Figure 1. The structure of 2-amino-6-hydroxybenzothiazole.

The tubular flow cell is easily constructed from an ordinary stainless steel or copper tubes and a graphite rod. Equipment needed for this method can be easily and cheaply obtained through non-scientific commercial sources. The use of this flow cell has advantages such as reducing the use of supporting electrolyte, increasing yield, lower electrical resistance and lower energy consumption.

Keywords: Hydroquinone, Flow cell, Electrochemical synthesis, 2-aminobenzothiazole.

References

[1] Y. He, J. Li, S. Luo, J. Huang, Q. Zhu, Chem. Commu. 54 (2016) 8444-7.

New insights into the electrochemical behavior of sunset yellow azo dye in aqueous solutions

Nader Fathi,[a] Davood Nematollahi[a,b]*

[a]*Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran*
[b]*Planet Chemistry Research Center, Bu-Ali Sina University, Hamedan, Iran.*
*E-mail: fathi137310@gmail.com

Abstract:

As an azo dye, Sunset Yellow also known as Orange Yellow S, Yellow 6, is represented in Europe by E Number E110 or C.I. 15985 [1]. In this research, electrochemical behavior of Sunset Yellow (Figure 1) has been comprehensively studied in aqueous solutions with different pH values, using different voltammetry techniques such as cyclic voltammetry, chronoamperometry, chronopotentiometry, etc. The result of this work is to provide a detailed and comprehensive mechanism for Sunset Yellow oxidation that has not been reported so far.

Background:

Sunset yellow with a long history of use in a wide color range from yellow to orange is a widely used artificial colorant containing azo group and is easily found in common food products such as drinks, desserts and candies. Although voltammograms of Sunset Yellow has been reported in a relatively large number of papers, most of these studies have been conducted in order to optimize the conditions for the analysis and measurement of yellow sunset. Therefore, we decided to investigate its electrochemical behavior completely and comprehensively so that there is no ambiguity in this matter.

Results:

The cyclic voltammogram of Sunset Yellow at pH 5 and at a scan rate of 500 mV/s is shown in Figure 2. This figure alone shows the complexities of the Sunset Yellow oxidation process and the need for thorough study to expand the frontiers of knowledge.

Significance:

In this study, the electrochemical behavior of Sunset Yellow in aqueous solution with different pH values was investigated and the results including oxidation mechanism, adsorption/diffusion behavior and pH potential diagrams were reported.

Keywords: Sunset Yellow, Oxidation mechanism, Cyclic voltammetry.

References:

[1] F.C. Moreira, S. Garcia-Segura, V.J. Vilar, R.A. Boaventura, E. Brillas, Appl. Catal. B: Environ. 142 (2013) 877-890.

Last-stage modification of olanzapine through its electrochemical oxidation in the presence of arylsulfinic acid derivatives

Sajad Shanesaz,[a] **Davood Nematollahi,**[a,b*]

[a]*Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran*

[b]*Planet Chemistry Research Center, Bu-Ali Sina University, Hamedan, Iran.*
[*]E-mail: Sajad.shanesaz.hmd@gmail.com

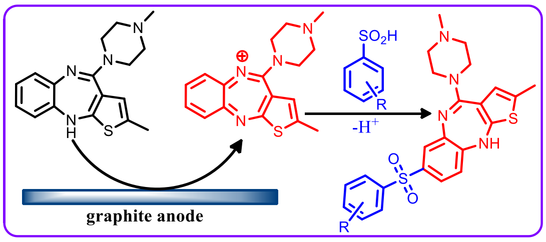
Abstract: The electrochemical oxidation of olanzapine in the presence and absence of arylsulfinic acids (nucleophile) in a mixture of buffer with different pH and ethanol was investigated by cyclic voltammetry. The results showed that the oxidized olanzapine reacts with the nucleophile and turns into the final product. The final product is a new derivative of olanzapine in which an arylsulfinic group has been added to olanzapine. Last-stage functionalization of olanzapine was successfully carried out by applying a constant current on the graphite electrode in a simple cell. In this work, some new olanzapine derivatives were synthesized with high yield without toxic reagents and solvents using an environmentally friendly method.

Background:

Olanzapine (Scheme 1) is an antipsychotic drug used to treat schizophrenia and prevent bipolar disorder. In this work, the electrochemical oxidation mechanism of olanzapine have been systematically studied using cyclic voltammetry to better understand its reactivity, efficacy, and finally its side effects [1].

Results:

The results of this research indicate that olanzapine is oxidized on the graphite anode electrode. Then this intermediate is attacked by benzenesulfinic acid and becomes the final product. Electrochemical oxidation of olanzapine in the presence and absence of arylsulfinic acid Show in Scheme 1.



Scheme 1. Electrochemical oxidation of olanzapine in the presence and absence of arylsulfinic acids

Significance:

Investigating the electrochemical behavior of drugs gives us a general view of possible oxidation and regeneration of this drug in the environment. Also, the new derivatives synthesized in this work may show better medicinal effects in the future.

Keywords: Olanzapine, Benzensufinic acid, Electrochemical synthesis, Last-stage modification of drugs.

References

[1] R. P. Bacil, P. H.Garcia, W. R. de Araujo, S. H. P. Serrano, Electrochim. Acta 368 (2021) 137683

Electrochemical determination of copper ions in waste water using a lab-made triple graphite electrode based on polishable triple electrode

Ali Rasi Mahmoudi[a], Mehrdad Abbasi Mahmoudabad[a], Karim Asadpour-Zeynali[a]*

[a]*Department of Analytical Chemistry, Faculty of Chemistry, University of Tabriz, Tabriz, Iran*

**E-mail:* K.zeynali@gmail.com

Abstract

Electrochemical sensing has witnessed significant advancements, driven by the demand for rapid, sensitive, and cost-effective analytical techniques. However, the development of low-cost and portable sensing systems remains a challenge. This study aims to address this issue by designing and fabricating a three-electrode system based on polishable Triple Electrode [1]. A three-electrode system was constructed using graphite electrodes derived from pencil lead. Cyclic voltammetry experiments demonstrated the system's ability to generate stable and reproducible electrochemical signals. The system was successfully applied to the quantitative determination of copper ions in a waste water sample, exhibiting a wide linear range and high sensitivity. The influence of various parameters, such as buffer type and pH, on electrode performance was investigated, revealing their crucial role in optimizing sensitivity and selectivity. The accurate determination of copper ions in wastewater is essential due to its toxicity and environmental impact. This study's findings contribute to the development of practical and affordable solutions for monitoring copper levels in wastewater. This innovative electrochemical system offers several advantages, including low cost, ease of fabrication, and high sensitivity. Its portability and potential for miniaturization make it suitable for diverse applications, such as drug analysis, quality control, and environmental monitoring. The findings of this study contribute to the development of more accessible and affordable electrochemical sensing technologies.

Keywords: Polishable triple electrode, copper ion, pseudo-reference electrode, micro-volume cell.

References

[1] M. Abbasi, A. Rasi Mahmoudi, K. Asadpour-Zeynali, Sensing and Bio-Sensing Research, 43 (2024) 100635.
[2] E. Tesfaye, B. Chandravanshi, N. Negash, M. Tessema, RSC advances, 12.54 (2022): 35367-35382.

Electrochemical synthesis of new linezolid derivatives through the electrochemical oxidation of linezolid in the presence of arylsulfinic acids

Mahya Miri[a], Davood Nematollhi[ab*], Nilofar mohamadighader[a]

[a]*Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran*
[b]*Planet Chemistry Research Center, Bu-Ali Sina University, Hamedan, Iran.*
[*]*E-mail:* mahmiriz.1372@gmail.com

Abstract: Our main goal in this work is to synthesize new linezolid derivatives according to the principles of green chemistry and also to provide a unique mechanism for their synthesis. Some new linezolid derivatives were synthesized through the anodic oxidation of linezolid in aqueous/acetonitrile mixtures in the presence of arylsulfinic acids at carbon electrode surface. The results show that oxidized linezolid as a reactive intermediate reacts with arylsulfinic acid and forms the final product. This work has led to the development of an efficient, green and easy electrochemical method for the synthesis of new linezolid derivatives.

Background

Linezolid belongs to a class of antibiotics called oxazolidinones [1]. In this abstract, we have synthesized some new linezolid derivatives through the electrochemical oxidation of linezolid in the presence of arylsulfinic acids.

Results:

Figure 1 shows the cyclic voltammogram of a 1 mM solution of linezolid in a water/acetonitrile mixture (phosphate buffer, pH 2, c = 0.2 M) in the absence (a) and presence (b) of toluenesulfinic acid. By comparing two voltammograms a and b, it can be seen that after adding toluenesulfinic acid in the reverse scan, the peak current C_1, which is related to the reduction of oxidized linezolid, has decreased significantly. This phenomenon is undeniable evidence to confirm the reaction of toluenesulfinic acid with oxidized linezolid.

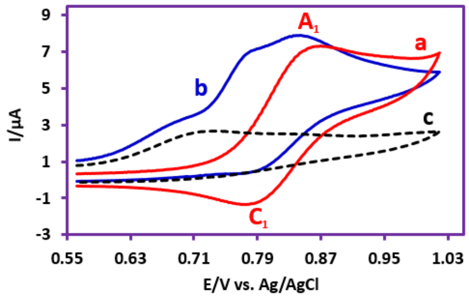


Figure 1: Cyclic voltammograms of linezolid (1 mM): a) in the absence, b) in the presence of toluenesulfinic acid (1 mM) and c) cyclic voltammogram of toluenesulfinic acid (1 mM) on the surface of the glassy carbon electrode, in water/acetonitrile mixture (phosphate buffer, pH 2, c = 0.2 M). Potential scan rate: 100 mV/s at room temperature.

Significance:

This work is focused on the electrochemical synthesis of linezolid derivatives, a common antibiotic drug. No catalysts, reagents or toxic solvents are required in this method.

Keywords: Linezolid, arylsulfinic acids, Antibiotics, Anodic oxidation.

References

[1] D. Merli, L. Pretali, E. Fasani, A. Albini, A. Profumo, *Electroanalysis*, *23* (2011) 2364-2372.

Synthesis, characterization and Comparing the electrocatalytic performance of Ru-Ni MOF/NF and Ru-Co MOF/NF for glycine oxidation

Mir Ghasem Hosseini[a], Naser Abbaszadeh[b]*

[a]*Department of Physical chemistry, Faculty of chemistry, Tabriz University, Tabriz, Iran*

[b]*Department of Physical chemistry, Faculty of chemistry, Tabriz University, Tabriz, Iran*

**E-mail: Naser95Abbaszadeh@gmail.com*

The development of efficient electrocatalysts for the oxidation of organic fuels, such as amino acids, is critical for the advancement of fuel cell technologies[1]. In the field of polymer fuel cell development, the use of metal-organic frameworks as emerging catalysts has received special attention[2]. Glycine, a simple and readily available amino acid, has garnered attention as a potential fuel due to its ease of oxidation in alkaline conditions and renewable nature. This study compares the electrocatalytic performance of Ru-Ni MOF and Ru-Co MOF, two metal-organic frameworks stabilized on nickel foam, in the electrooxidation of glycine. The Ru-Ni MOF and Ru-Co MOF were synthesized via a hydrothermal method and immobilized on nickel foam substrates (NF) [3]. The electrocatalysts were characterized by XRD, SEM, Raman and FT-IR to confirm their structural integrity and surface properties. Electrochemical measurements were conducted in a three-electrode setup with 1M NaOH and 0.05M glycine as the electrolyte. CV, CA, CP and EIS were performed to evaluate the catalytic activity and stability of both electrocatalysts. This study provides a detailed comparison of Ru-Ni MOF/NF and Ru-Co MOF/NF as electrocatalysts for the oxidation of glycine in alkaline media. The Ru-Ni MOF/NF demonstrated superior electrocatalytic activity, stability, and charge transfer efficiency, making it a more promising candidate for applications in amino acid-based fuel cells.

Keywords: Ru-Ni MOF, Ru-Co MOF, Glycine Electrooxidation, Nickel Foam, Electrocatalysis

References

[1] Mohan, R., Modak, A., Subramanian, P., Cahan, R., Sivakumar, P., Gedanken, A., & Schechter, A. (2020). Electrochemical oxidation of glycine with bimetallic nickel− manganese oxide catalysts. *ChemElectroChem*, *7*(2), 561-568.

[2] Mohammadi, T., Hosseini, M. G., Pastor, E., & Ashassi-Sorkhabi, H. (2024). One-step growth of RuNi-MOF nanoarrays on carbon felt host as a high-performance binder-free electrode for dual application: Ethanol fuel cell and supercapacitor. *Journal of Energy Storage*, *79*, 110146.

[3] Xu, Y., Yu, S., Ren, T., Liu, S., Wang, Z., Li, X., ... & Wang, H. (2020). Hydrophilic/aerophobic hydrogen-evolving electrode: NiRu-Based metal–organic framework nanosheets in situ grown on conductive substrates. *ACS applied materials & interfaces*, *12*(31), 34728-34735.

Synthesis of Cabbage Like Micropellets of $Co(OH)_2$/ P-Doped-Graphitic Carbon Nitride as a Bifunctional Electrocatalyst to ORR and OER

Seyedeh. Fatemeh. Nami-Ana[a], J. Tashkhourian*[a], M. Shamsipur[b]

[a]*Department of Chemistry, College of Sciences, Shiraz University, Shiraz 71456, Iran*
[b]*Department of Chemistry, Razi University, Kermanshah, Iran*
**E-mail: Tashkhourian@susc.ac.ir*

Abstract

Oxygen reduction/evolution reactions (ORR/OER) are the key barriers in various electrochemical devices such as metal–air batteries, fuel cells, and electrolyzers [1]. An appropriate cobalt-based material structure is believed to enhance the electrocatalytic activity for ORR and OER. Moreover, it is reported that the transition metal hydroxide could be indeed improved by tuning the morphology and composition [2].

Background:

- Cobalt-based materials such as cobalt oxides (CoO, Co_3O_4) have been widely investigated as non-precious metal electrocatalysts for ORR and OER [3].
- Finding stable and efficient oxygen electrocatalysts, which drive both reactions, are difficult because good catalysts for ORR often tend to be poor for OER and vice versa.

Results:

Flower like micropellet of $Co(OH)_2$/phosphorus-doped carbon nitride ($P\text{-}C_3N_4$) was successfully prepared. At the first step $P\text{-}C_3N_4$ nanosheets were synthesized by direct thermal co-poly-condensation using poly sodium phosphate as the phosphorus source and GuCl as the $g\text{-}C_3N_4$ precursor. At the second step $Co(OH)_2$ was deposited. The performance of synthesized nanocomposite toward oxygen evolution and also to oxygen reduction was investigated by LSV, CV and analyzing data. Then the cobalt hydroxide was synthesized. The overpotential of 10, 20, 30 mA cm^{-2} for 20% $Co(OH)_2$/ $P\text{-}C_3N_4$ was obtained 240, 340 and 390 mV, respectively that are lower than that the value of 310, 380 and 450 mV for 10%. They showed a slight difference than those obtained for 30%; 310mV for 30mAcm^{-2} 330 mV while 30% $Co(OH)_2$/ $P\text{-}C_3N_4$ showed more capacitive current leading to difficulty reading of the current density of 10 mA cm^{-2} for 30% $Co(OH)_2$/ $P\text{-}C_3N_4$.

Keywords: Oxygen reduction, Evolution eactions, Electrocatalyst, phosphorus-doped carbon nitride ($P\text{-}C_3N_4$), Cabbage Like Micropellets

References

[1] A. Ashok, A. Kumar, J. Ponraj, S.A. Mansour and F. Tarlochan, *International Journal of Hydrogen Energy*, 44 (2019) 16603.
[2] K.Y. Niu, F. Lin, S. Jung, L. Fang, D. Nordlund, C.C.L. McCrory, T.C. Weng, P. Ercius, M.M. Doeff and H. Zheng, *Nano Letters*, 15 (2015) 2498.
[3] Y. Gorlin and T.F. Jaramillo, *Journal of the American Chemical Society*, 132 (2010) 13612.

Electrochemical degradation of Azithromycin in aqueous solutions: Investigating the efficacy of $Ti/TiO_2/\beta PbO_2$ anodes

Nasrin Hadavand[a], **Sadegh Khazalpour**[a*], **Davood Nematollahi**[a], **Lida Fotouhi**[b]
[a] *Department of Analytical Chemistry, Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran.*
[b] *Department of Analytical Chemistry, Faculty of Chemistry, Alzahra University, Tehran, Iran*
[*] *E-mail: S.khazalpour@basu.ac.ir, Khazalpour@gmail.com; Phone: +98 918 310 3793*

Antibiotics, specifically azithromycin, are one of the resistant pharmaceutical residues increasingly found in aquatic environments, posing a rising danger to ecological health [1,2]. Given their potential to cause damage to the ecosystem and human health, this impact is huge unless effective remediation strategies are developed. Efficient and eco-friendly technologies for the removal of antibiotics from wastewater are thus important and inescapable for ensuring both human and environmental well-being [3].

Although various advanced oxidation processes (AOP) methods have been used to degrade pharmaceutical pollutants, the optimal application of these technologies has not been well investigated. While PbO_2 electrodes are effective for the treatment of wastewater [4], surface modifications can further optimize their electrochemical performance and increase their operational lifetime [5]. A review of the past literature shows that no research has been carried out for the degradation and mineralization of azithromycin (Azi) by PbO_2-based electrodes. Therefore, the importance of further study and research in this field is revealed.

In this research, a $Ti/TiO_2\text{-}\beta PbO_2$ electrode was synthesized for the electrochemical degradation of Azi. To increase the efficiency and stability of the electrode, βPbO_2 electrodeposition was performed in the presence of sodium dodecyl sulfate. Degradation efficiency and COD removal after 20 minutes of electrolysis of Azi aqueous solution at a concentration of 50 mg L^{-1} and a current density of 15 mA cm^{-2} at pH 7 were obtained as 100% and 49.41%, respectively. The findings provided a satisfactory electrode performance and a promising prospect for treating wastewater containing non-combustible organic pollutants.

Keywords: βPbO_2 electrode, electrochemical oxidation, degradation, azithromycin, antibiotic.

References

[1] E.M. Guerra and D.T. Cestarolli, *Journal of Alloys and Compounds*, 885 (2021) 160997.
[2] J. Wang and S. Wang, J. Environ. Manage, 182 (2016) 620–640.
[3] Q. Q. Zhang, G. G. Ying, C. G. Pan, Y. S. Liu and J. L. Zhao, Environ. Sci. Technol, 49 (2015) 6772–6782.
[4] J. Niu, H. Lin, J. Xu, H. Wu and Y. Li, *Environ. Sci. Technol*, 46 (2012) 10191–10198.
[5] Q. Dai, Y. Xia and J. Chen, *Electrochim. Acta*, 188 (2016) 871–881.

Heteroatom doping of red phosphorus and sulfur in g-C_3N_4 and the combination with N-doping ZnO nanorods as a novel heterojunction and effective approach for developing photoanode in dye-sensitized solar cells

Fatemeh Shiravani, Javad Tashkhourian,* Omid Estakhr, and Amin Reza Zolghadr

Department of Chemistry, Faculty of Sciences, Shiraz University, Shiraz 71454, Iran
*E-mail: Mahsashiravani_97@yahoo.com

Abstract The non-renewable nature of fossil fuels poses a considerable challenge environmental threats. [1] The nature has conferred us a source of clean, free, and endless energy resources in the form of solar energy.[2] It is estimated that about 0.01% of the energy from one second of sunlight is sufficient for the annual energy consumption of human society; and can be converted into valuable electricity.[3],[4] In this work, a novel heterojunction of P, S-doped g-C_3N_4 with combination N-doped ZnO nanorods is reported for the first time as a highly effective photoanode electrode in dye-sensitized solar cell (DSSC). Phosphorous and sulfur doped g-C_3N_4 have been successfully synthesized by the facile eco-friendly thermally copolymerization of red phosphorus (RP) and urea. The synergistic effect of P, S-doped g-C_3N_4 in combination with the N-doped ZnO increases the surface area of ZnO and g-C_3N_4, which assists to dye uptake and faster electron transfer. The optimized DSSC based on NZnO-P-doped g-C_3N_4 (NZnO-PCN) photoanode shows J_{SC} ~20.50 mA cm^{-2}, V_{OC} ~0.67 V, fill factor (FF) ~0.64 and power conversion efficiency (PCE) ~8.8%. The power conversion efficiency was 7.3% for ZnO-P-doped g-C_3N_4 (ZnO-PCN), 5.8% for NZnO-S-doped g-C_3N_4 (NZnO-SCN), and 4.5% for ZnO-S-doped g-C_3N_4 (ZnO-SCN). Electrochemical studies including electrochemical impedance spectroscopy (EIS) and cyclic voltammetry (CV), confirmed that the remarkable improvement in the PCE of NZnO-PCN can be attributed to the combined effects of increased carrier concentration, morphology change, and enhanced Fermi energy level caused by N and especially RP doping in ZnO and g-C_3N_4, respectively.

Keywords: dye-sensitized solar cell, heteroatoms; graphitic carbon nitride; energy conversion; novel heterojunction

References

[1] K. Fan, J. Yu, W. Ho, *Mater. Horiz* **2017**, *4*, 319-344.
[2] W. S. W. Abdullah, M. Osman, M. Z. A. Ab Kadir, R. Verayiah, *Energies* **2019**, *12*, 2437.
[3] E. Fan, L. Li, Z. Wang, J. Lin, Y. Huang, Y. Yao, R. Chen, F. Wu, *chem. Rev* **2020**, *120*, 7020-7063.
[4] A. Rashedi, T. Khanam, *Environ. Sci. Pollut. Res.* **2020**, *27*, 29075-29090

Ion Selectivity in Carbon Nanotubes on Graphene Substrates for Supercapacitor Electrodes

Mohammad Kamalvand[a]*, **Tahmineh Keshavarzi**[b]
[a]*Department of Chemistry, Faculty of Science, Yazd University, Yazd, Iran*

[b]*Department of Chemistry, Isfahan University of Technology, Isfahan, Iran*

**E-mail: kamalvand@yazd.ac.ir*

The transition to a sustainable energy future necessitates efficient and cost-effective electricity storage. Electrochemical capacitors, known for their rapid charge-discharge capabilities, often utilize porous carbons for high capacitance. However, this can result in low energy density. This research investigates the complex relationship between pore size and ion adsorption within carbon nanotubes (CNTs) using molecular dynamics simulations [1-2].

We modeled a representative electrode consisting of four CNTs with varying diameters (7, 14, 20, and 27 angstroms) fixed on a flat graphene sheet. The behavior of a 10% w/w NaCl/water electrolyte was analyzed, revealing that ions could not penetrate CNTs with diameters of 7 and 14 angstroms. This contradicts the common belief that smaller pores enhance adsorption. However, larger CNTs allowed ion penetration, with smaller pores (20 angstroms) exhibiting higher diffusion than larger ones (27 angstroms) and the flat graphene surface. Furthermore, a notable imbalance in ion entry into the CNTs, even with a neutral electrode, resulted in a lack of charge neutrality within the pores. This charge imbalance is influenced by the CNT diameter and ion size ratio.

These findings emphasize the importance of tailoring CNT diameters to optimize ion absorption efficiency in electrochemical capacitors. By carefully selecting pore sizes, we can design electrodes that facilitate ion adsorption and contribute to the development of high-performance energy storage devices.

Keywords: Supercapacitor, Nanostructure, Density profile, Molecular Dynamics simulation

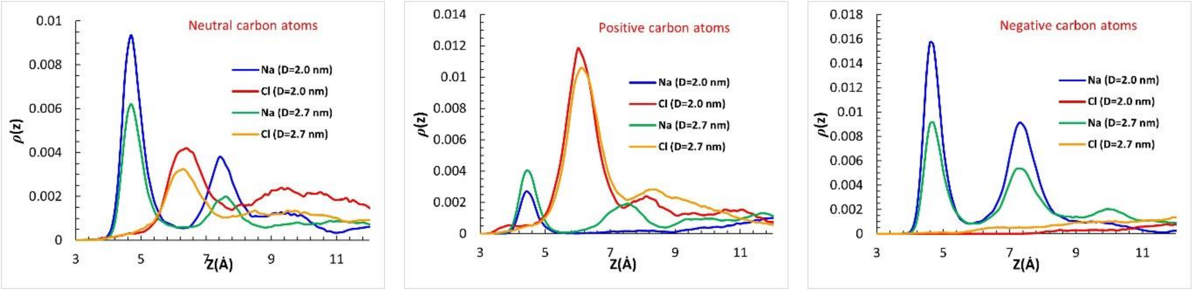


Fig. 1 Density profiles of Na^+ and Cl^- ions perpendicular to the graphene sheet. These calculations were performed for ions inside various carbon nanotubes and under different carbon atom charges.

References

[1] R. K. Kalluri, D. Konatham, and A. Striolo, *J. Phys. Chem. C.* 115 (2011), 13786.
[2] Z. Bo, C. Li, H. Yang, K. Ostrikov, J. Yan, K. Cen, *Nano-Micro Lett*. 10(2018), 33.

Designing a non-enzymatic photoelectrochemical sensor for glucose by using Fe-doped NiS_2

Ghasem Abollahi[a], Mohammad Hosein Mashhadizadeh Ardakani[b]*

[a]*Department of Chemistry Faculty of Kharazmi University, Tehran, Iran*

[b]*Department of Chemistry, Faculty of Kharazmi, University, Tehran, Iran*

[*]*E-mail: Abdollahi.gh@gmail.com*

Glucose biosensors have gained popularity and application because glucose sensing is critical for diabetes diagnosis[1]. photoelectrochemical sensing is a promising technique that utilizes light as the excitation source and electrical energy for signal detection[2].

In this research, the combination of Fe/NiS_2 nanostructure with photocatalytic properties and using it a non-enzymatic glucose sensor was designed and built, and the properties of the built sensor were investigated in the conditions of ambient light, darkness and visible light. We chemically synthesized Fe-doped NiS_2 (Fe/NiS_2) and used it as a carbon paste modifier to achieve this goal.

Hydrothermal method was used to prepare Fe/NiS_2.The electrochemical properties of Fe/NiS_2 were investigated using cyclic voltammetry, amperometry and electrochemical impedance spectroscopy.

The proposed Fe/NiS2 enzyme-free photocatalytic sensor catalyzed the oxidation of glucose on the electrode surface in the presence of irradiated visible light. In order to evaluate and investigate the ability of electrode modified with Fe/NiS_2 as a non-enzymatic photocatalytic sensor for measuring glucose, amperometric technique was used, the merit figures including sensitivity, detection limit, linear range, repeatability and reproducibility for modified electrode. It was investigated with the method presented in this research and compared with other methods in other articles. Also, the effect of interfering species and the ability to measure glucose in a real body sweat sample were investigated for the designed electrode and the results showed that the use of this sensor is suitable for measuring glucose in body sweat. This sensor has a wide linear range (1.5×10^{-3}-0.08 and 0.08-6.3 mM), low detection limit (0.45 µM), long-term stability and good selectivity. Finally, this sensor was used to determine the amount of glucose in human sweat samples.

Keywords: non-enzymatic, photoelectrochemical, glucose

References

[1] K. V. Jarnda *et al.*, “Recent advances in electrochemical non-enzymatic glucose sensor for the detection of glucose in tears and saliva: A Review,” *Sensors Actuators A Phys.*, vol. 363, p. 114778, 2023, doi: https://doi.org/10.1016/j.sna.2023.114778.

[2] E. P. Gür, Z. S. B. Yılmaz, S. Dinç, and Ü. Demir, “A self-powered photoelectrochemical and non-enzymatic glucose sensor based on ERGO/ZnONWs/CdS photoanode,” *Electrochim. Acta*, vol. 501, p. 144825, 2024, doi: https://doi.org/10.1016/j.electacta.2024.144825.

Determination of Deferiprone drug by nanoparticles modified glass carbon electrode

Zahra Akbarzad Sangrizeh[a], Seyed Karim Hassaninejad-Darzi [a]*, Neda Zalpour[b]

[a] Department of Chemistry, Faculty of Basic Science, Babol Noshirvani University of Technology, Shariati Ave., P.O. Box: 484, Babol 47148-71167, Iran

[b] Department of Chemistry, Faculty of Sciences, Ilam University, Ilam P. O. BOX. 69315-516, Iran

**E-mail: zakbarzad2021@gmail.com*

Abstract:

This study describes a new electrochemical sensor for the sensitive detection of deferiprone, an iron chelating drug used in the treatment of thalassemia. In addition, deferiprone inhibits HIV replication, functioning as an anti-HIV agent [1-4]. The sensor of this work was fabricated by modifying a glassy carbon electrode (GCE) with a UiO-66/KB-Chi nanocomposite. Characterization using field emission scanning electron microscopy (FESEM) and energy-dispersive X-ray spectroscopy (EDX) revealed a uniform distribution of Ketjen Black on the UiO-66 surface, which effectively enhanced its conductivity. The electrochemical behavior of deferiprone at the modified GCE was investigated using differential pulse voltammetry (DPV) and cyclic voltammetry (CV).

However, an electrochemical method was used in this research that UiO-66/KB-Chi/GCE demonstrated superior reproducibility, cost-effectiveness, stability, and performance, along with significant conductivity and a low detection limit.Under optimized conditions, the sensor exhibited an excellent detection limit of 1.407 µM and two linear dynamic ranges of 5.40-919.96 µM and 1003.05-6313.65 µM (Figure 1). These findings validate the suitability of this sensor for the quality control of drugs in the pharmaceutical industry.

References:

[1] Narang, J., Malhotra, N., Singh, G., & Pundir, C. S. (2015). Voltammetric detection of anti-HIV replication drug based on novel nanocomposite gold-nanoparticle-CaCO3 hybrid material. Bioprocess and Biosystems Engineering, 38(5), 815–822. https://doi.org/10.1007/s00449-014-1323-1

[2] Kontoghiorghes, G., Pattichis, K., Neocleous, K., & Kolnagou, A. (2004). The Design and Development of Deferiprone (L1) and Other Iron Chelators for Clinical Use: Targeting Methods and Application Prospects. Current Medicinal Chemistry, 11(16), 2161–2183. https://doi.org/10.2174/0929867043364685.

[3] Benoit-Biancamano, M.-O., Connelly, J., Villeneuve, L., Caron, P., & Guillemette, C. (2009). Deferiprone Glucuronidation by Human Tissues and Recombinant UDP Glucuronosyltransferase 1A6: An in Vitro Investigation of Genetic and Splice Variants. Drug Metabolism and Disposition, 37(2), 322–329. https://doi.org/10.1124/dmd.108.023101.

The effect of electroplating solutions on the electrochemical and morphological of the electrode surface in gold electroplating

Yasaman Mozafarikhah, Ali Benvidi*

Department of Chemistry, Yazd University, Yazd, Iran
**E-mail: benvidi89@gmail.com, abenvidi@yazd.ac.ir*

Abstract

Gold has excellent physical and chemical properties and is widely used in the electronics and jewelry industries. The low strength of gold limits its use in many fields and how to improve the strength of gold has been one of the common concerns of this industry. Alloying is a traditional process of strengthening metallic materials. By increasing the strength, this method reduces the amount of gold consumed and resistance to corrosion. Plating solutions have a great influence on the electrochemical properties and morphology of the electrode surface in gold plating. These effects include changes in structure, corrosion resistance, and electrical properties [1-3].

Our goal in this work is to investigate the effect of electroplating solutions on the electrochemical and morphological properties of the electrode surface in gold electroplating. In order to reach to target color and strength, two electroplating bathes were investigated. In addition of the bath solution composition, some of effective parameters such as temperature, time and plating current were optimized to be 60°C, 1 min, and 10 mA cm^{-2}, respectively.

Keywords: Electroplating, Electrochemical properties, Plating solutions, Morphology

References

[1] S. Dimitrijević, M. Rajčić-Vujasinović and V. Trujić, *International Journal of Electrochemical Science*, 8 (2013) 6620.
[2] L. Zheng and X. Yuan, *Materials Today Communications*, 31 (2022) 103711.
[3] B. Satpathy, M. S. Quraishy, T. K. Kundu, S. Dasn and K. Das, *Surfaces and Interfaces*, 40 (2023) 103132.

Investigating the stability of glucantime, an anti-leishmaniasis drug, using electrochemical methods

Armin Sadeghinia[a], Seyedmousa Motavallihaghi,[b] Sajad Shanesaz,[a] Davood Nematollahi[a,c]*

[a] *Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran*
[b] *Department of Medical Parasitology and Mycology, School of Medicine, Hamadan University of Medical Sciences, Hamadan, Iran*
[c] *Planet Chemistry Research Center, Bu-Ali Sina University, Hamedan, Iran*
*E-mail: a.sadeghinia@che.basu.ac.ir

Abstract: Leishmaniasis is a main global health concern, as the disease is widespread in 98 countries worldwide, with about two million new cases reported annually. Glucantime (*N*-methyl glucamine antimoniate) (meglumine antimoniate) is a pentavalent antimoniate is still the first line treatment and the choice medicine against leishmaniasis [1]. In this study, the cyclic voltammetry technique was used to investigate the stability of glucantime and the causes of the formation of antimony (III).

Background:

The use of antimony against leishmaniasis dates back to the 14th century. After that, the treatment of leishmaniasis with antimony (III) potassium tartrate started in 1913. However, due to the discovery of more effective and less toxic drugs prepared from pentavalent antimoniate, the use of trivalent antimonials was discontinued in the 1970s. finally, in this study, we decided to investigate the common opinion about the mechanism of side effects caused by glucantime drug, which is based on the presence of the Sb^{3+} species inside the solution.

Results:

Based on the obtained electrochemical data, it is clear that the glucantime drug complex has very good stability and Sb^{3+} species is not formed inside the drug solution.

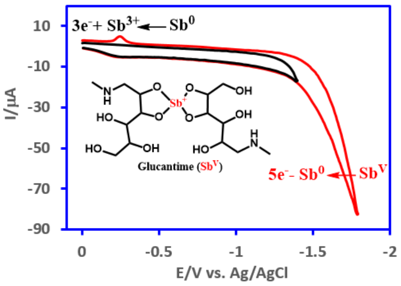


Figure 1. Cyclic voltammograms of glucantime (1.0 mM) at scan rate of 100 mV/s.

Significance:

In this study, one of the possible causes of side effects caused by Glucantime drug has been clarified.

Keywords: Glucntime, Cyclic voltammetry, Side effects.

References

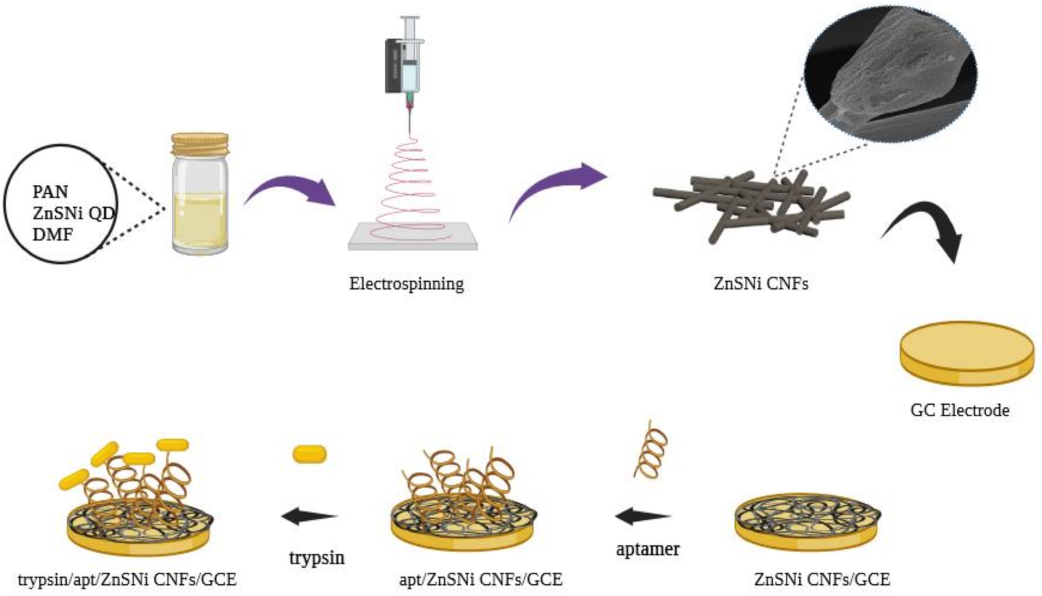
[1] P. Salaün, F. Frézard, *Anal. Bioanal. Chem.* 405 (2013) 5201-5214.

Development of Trypsin aptasensor based on electrospinning quantum dots into carbon nanofibers as a substrate

Haniye Shantiyaee, Mahmoud Roushani, Farzaneh Mohammadi*

Department of Chemistry, University of Ilam, Ilam, Iran

Email: mohammadi.farzaneh89@yahoo.com



Nowadays, because of the properties of carbon and its huge area of use, nanofibers are used by researchers in many nanobiotechnological areas [1]. Carbon nanofibers (CNFs) are CFs whose sizes are on the magnitude of nanometers. CNFs are high-performance nanostructured carbon materials [2]. They have all of the intrinsic qualities of carbon nanomaterials, including strong electrical conductivity, thermal stability, light weight, good mechanical qualities, and a large specific surface area with a compact structure [3]. Carbon nanofiber-based nanomaterials have revolutionized scientific research due to their exceptional electrical properties and could provide great opportunities to produce novel, ultrasensitive, and low detection limits sensing platforms such as electrochemical sensors and can serve as an immobilization matrix to create a biofunctional surface [4,5]. This study comprehensively investigates the biosensor incorporating ZnS:Ni quantum dots into electrospun nanofibers. This hybrid material was applied as a substrate for aptamer immobilization, aiming at Trypsin sensing. The electrochemical Trypsin aptasensor that was created using the unique ZnS:Ni/CNFs composite turned out to have superior analytical performance to the Trypsin aptasensors that had been previously reported. It had a broad linear range of 0.1 to 600 fg mL^{-1}, a low detection limit of 0.03 fg mL^{-1} (S/N = 3), excellent reproducibility, and selectivity.

Keywords: Electrospinning, Quantum dots, Aptamer, Trypsin.

REFERENCES:

[1] L. Li, D. Liu, K. Wang, H. Mao, T. You, Sensors and Actuators B: Chemical, 252 (2017) 17-23.
[2] F. Mohammadi, M. Roushani, H. Hosseini, New Journal of Chemistry, 48 (2024) 8074-8081.
[3] C. Ratlam, S. Phanichphant, S. Sriwichai, Journal of Polymer Research, 27 (2020) 183.
[4] F. Barati, A. Arpanaei, M. Mahmoudifard, Analytical Methods, 12 (2020) 3670-3681.
[5] P. Zhang, X. Zhao, Y. Ji, Z. Ouyang, X. Wen, J. Li, Z. Su, G. Wei, Journal of Materials Chemistry B, 3 (2015) 2487-2496.

Application of rapid techniques in the study of electrochemical mechanisms

Armin Sadeghinia[a], **Davood Nematollahi**[a,b]*

[a]*Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran*
[b]*Planet Chemistry Research Center, Bu-Ali Sina University, Hamedan, Iran.*
*E-mail: a.sadeghinia@che.basu.ac.ir

Abstract: The application of fast double potential step chronoamperometry and fast scan cyclic voltammetry techniques have been used in the study of electrochemical mechanisms.

Background:

Electrochemical mechanisms can include various combinations of charge transfer processes and chemical processes [1]. Coupling of charge transfer processes with chemical processes in some cases where the rate of chemical processes is too high leads to inaccuracies in the correct diagnosis of the overall mechanism. In such cases, by changing the time window of the electrochemical instrument, evidence can be obtained to correctly determine the overall mechanism. Tizanidine, a short-acting muscle relaxant (Figure 1), was studied using fast and slow techniques to demonstrate the importance of the time window in electrochemical studies.

Results:

The conventional and fast chronoamperograms of tizanidine are shown in Figure 1. While conventional chronoamperogram shows an irreversible oxidation due to a rapid chemical process after the charge transfer process, the fast technique refutes this and shows the presence of oxidized tizanidine on the electrode surface as an unstable intermediate.

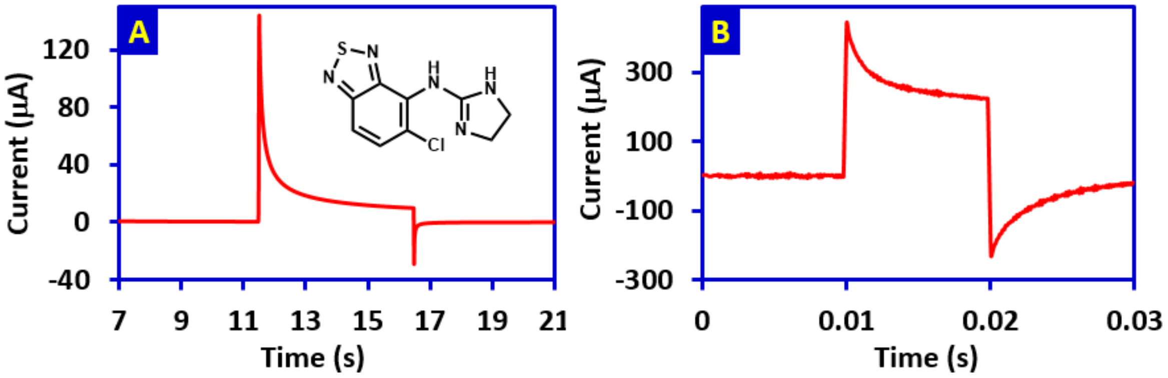


Figure 1. Conventional (A) and fast (B) chronoamperograms of tizanidine (1.0 mM) in buffer solution (pH 2.0). In both chronoamperograms, the potential is first set at 1.2 V, then 1.6 V, and then 1.2 V vs. saturated Ag/AgCl.

Significance:

In this study, the effect of using rapid electrochemical techniques on the correct determination of electrochemical mechanisms has been proven.

Keywords: Tizanidine, Chronoamperometry, Cyclic voltammetry, Electrochemical mechanism

References

[1] A.J. Bard, L.R. Faulkner, Electrochemical Methods, 2nd ed., Wiley, New York (2001).

Development and Characterization of a Novel Fluoride Ion Selective Electrode Utilizing Leonardite as a Functional Matrix

Faezeh Farrokhghate,[a] **Homa Ahmadi,**[a] **Sana Khosrozadeh Sarijalo,**[a] **Mohammad Kazemzadeh,**[a] **Pouya Abedi,**[a] **Khalil Farhadi**[a]*

[a]*Department of Analytical Chemistry, Faculty of Chemistry, Urmia University, Urmia, Iran*

**E-mail: khalil.farhadi@yahoo.com*
faezeh.ghateh@gmail.com

Fluoride ion measurement is crucial for ensuring safe drinking water, protecting public health, minimizing environmental pollution, and complying with industrial and environmental regulations [1]. Numerous analytical techniques such as atomic absorption spectroscopy (AAS), colorimetry, flow injection, gas chromatography (GC), nuclear magnetic resonance (NMR) spectroscopy, capillary zone electrophoresis (CZE), radio analysis, complexometry, and fluorometry have been employed for the determination of fluoride [2]. However, potentiometric methods are accurate, fast, economical, and sensitive compared to other usual methods [3]. Due to the hydrophilic nature of the fluoride ion, selecting a suitable ionophore for the construction of a fluoride-selective polymeric membrane electrode presents a significant challenge [4]. In the present work, Leonardite (which is an oxidized form of lignite rich in humic and fulvic acids and commonly used in agriculture to improve soil fertility, water retention, and nutrient availability) [5] was used as a carrier in PVC matrix to improve the sensitivity, selectivity and stability of polymeric membrane electrode toward fluoride ion. All of the parameters such as electrode composition, solution pH and ionic power were optimized. Under the optimal conditions, the proposed electrode shows sub-Nernstian response (42.9 mV/decade) with a linear dynamic range of 1×10^{-5} - 1×10^{-2} mol/L. Unique reproduciblity, fast response time, low cost, high stability and selectivity are the main advantages of the proposed fluoride electrode in potentiometric detection. The proposed electrode was successfully used for direct and titration potentiometric detection of fouoride in real samples.

Keywords*:* Ion selective electrode, Fluoride, Leonardite, potiontiometry, Membrane electrode

References

[1] N.R. Council, D.o. Earth, L. Studies, B.o.E. Studies, C.o.F.i.D. Water, Fluoride in drinking water: a scientific review of EPA's standards, (2007).

[2] Y.S. Solanki, M. Agarwal, A. Gupta, S. Gupta, P. Shukla, Fluoride occurrences, health problems, detection, and remediation methods for drinking water: A comprehensive review, Science of the Total Environment, 807 (2022) 150601.

[3] A. Bratovčić, A. Odobašić, S. Ćatić, The advantages of the use of ion-selective potentiometry in relation to UV/VIS spectroscopy, Agriculturae Conspectus Scientificus, 74 (2009) 139-142.

[4] M.S. Frant, J.W. Ross Jr, Electrode for sensing fluoride ion activity in solution, Science, 154 (1966) 1553-1555.

[5] K.H. Tan, Humic matter in soil and the environment: principles and controversies, CRC press2003.

Electrochemical deposition of metal oxide thin-layers on FTO glass for sensor applications

Hamid Dehghan-Manshadi[a], **Mohammad Mazloum-Ardakani**[b]*, **Zahra Esamaeili**[b]

[a]Thin Layer and Nanotechnology Laboratory, Department of Chemical Technologies, Iranian Research Organization for Science and Technology (IROST), P.O. Box 33535-111, Tehran, Iran

[b]Department of Chemistry, Faculty of Science, Yazd University, Yazd, Iran

**E-mail: mazloum@yazd.ac.ir*

Abstract: Electrochemical deposition is a method for coating conductive/semi-conductive materials onto a conductive substrate using an electric field and redox reaction. This method is a high-performance technique in the design and preparation of selective surfaces for sensor applications [1]. One of the important biological markers in the human body is creatinine which has a useful role in the recognition of different kidney and cardiovascular diseases. The amount of creatinine in the blood serum of humans is commonly recognized as an indicator of renal health [2, 3]. In this work, an electrochemical deposition method based on isoelectric points of sensor components and creatinine was used to obtain a high-selective creatinine sensor. For this purpose, the surface of fluorine-doped tin oxide glass (FTO) was modified using reduced graphene oxide (rGO) and utilized as the substrate for electrodeposition of metal oxides on its surface according to dissimilarities in the isoelectric points of rGO (IEP=2.5) and metal oxide nanoparticles. Also, without metal oxide spaces were created by placing poly(vinyl alcohol) (PVA) strips on the substrate before electrodeposition and removing them after synthesis and stabilization of metal oxides. This hierarchical surface creates a good condition for adsorption of creatinine into rGO surface with dissimilar charge and interaction with metal oxides.

Keywords: Metal oxides, Thin-layer, Electrodeposition, Creatinine, FTO glass

References

[1] H. M. Saleh, A. I. Hassan. *Sustainability*, 15 (2023) 10891.
[2] H. Dehghan-Manshadi, M. Mazloum-Ardakani, S. A. Mozaffari. *Biosensors and Bioelectronics*, 246 (2024) 115881.
[3] S. Ghayempour, M. Mazloum-Ardakani, H. Dehghan-Manshadi, "Semiconducting Fibers for Sensors." In Semiconducting Fibers, *CRC Press* (2024) 152.

Graphite mini-chip platform modified with functionalized multi-walled carbon nanotubes as a disposable electrochemical sensor for the quality control of pharmaceutical preparations

Fatemeh Mirafzali[a], Narges Ashraf[a]*

[a] *Department of Chemistry, Faculty of Science, Ferdowsi University of Mashhad, Mashhad, Iran*

* *E-mail: ashraf-n@um.ac.ir*

Abstract

Acetaminophen has been used for more than a century to reduce pain and fever in different illnesses. Due to their widespread consumption, increasingly poor-quality production of pharmaceutical preparations containing acetaminophen as an active ingredient is leading to some potential risks to human health [1]. Hence, monitoring the acetaminophen dosage in a given pharmaceutical formulation at the end of production line is of crucial importance. Present research introduces a disposable electrochemical sensor based on functionalized multi-walled carbon nanotubes modified graphite mini-chip (GCHIP/MWCNT-COOH) for the determination of acetaminophen in pharmaceutical preparations. The modified mini-chip was characterized by transmission electron microscopy (TEM) and scanning electron microscopy (SEM). Moreover, cyclic voltammetry was used to study the electrochemical behavior of acetaminophen in Britton-Robinson buffer at pH 9. The effect of important influential operating parameters was thoroughly investigated and optimized. Under the optimum operating conditions, the calibration curve was constructed using differential pulse voltammetry technique, which showed three linear concentration ranges over the ranges of 0.05-10 µM, 10-100 µM, and 100-800 µM. Based on $3S_b/m$ and $10S_b/m$ criteria, the limit of detection (LOD) and the limit of quantification (LOQ) of the proposed sensor were obtained to be 0.03 µM and 10 µM, respectively. Also, the repeatability and reproducibility of the method were achieved to be 2.9% and 2.7%, respectively. The practical applicability of the proposed sensor was successfully demonstrated through the determination of acetaminophen in different pharmaceutical samples. The proposed sensor showed excellent sensitivity, good stability, good selectivity, as well as excellent repeatability and reproducibility.

Keywords: Acetaminophen, Graphite mini-chip, Functionalized multi-walled carbon nanotubes, Electrochemical sensor.

References

[1] N. T. Anh, L. M. Tung, L. K. Vinh, N. V. Quy, O. V. Hoang, N. X. Dinh and A. Le, *Nanoscale Advances*, 2024, 6, 256

Enhanced Corrosion Resistance of Mg AM60 Alloy via Modified CECAP Process for Biomedical Applications

Mir Hasan Seyyedi[a], Vali Alimirzaloo[a*], Hurieh Mohammadzadeh[b], Robabeh Jafari[b]

[a]*Department of mechanical engineering, Faculty of Technology and Engineering, Urmia University, Iran*

[b]*Department of material engineering, Faculty of Technology and Engineering, Urmia University, Iran*

[*]*E-mail: valimirzaloo@gmail.com*

Magnesium and its alloys have garnered significant interest as potential alternatives to conventional implant materials like titanium alloys and stainless steel. Magnesium alloys are more similar to bone in terms of density (Mg alloys: 1.74-2.0 g/cm^3; bone: 1.8-2.1 g/cm^3) and elastic modulus (Mg alloys: 41-45 GPa; bone: 3-20 GPa) [1]. Magnesium-based alloys can be categorized into four groups based on composition: pure magnesium, aluminium alloys (e.g. AZ91, AZ31, LAE422, AM60) [2]. Mg AM60 alloy has been studies in simulated body fluid (SBF) due to its enhanced corrosion resistance from aluminium content, favourable mechanical properties, controlled degradation rate, which minimizes hydrogen evolution and cost-effective, making it an attractive option over other magnesium alloys for biomedical applications [3]. In this study, the effects of three different temperatures (225, 250, and 275°C) and two production rates (5 and 15 mm/min) on the corrosion behaviour of Mg alloys were investigated using severe plastic deformation (SPD) based on A new modified cyclic extrusion channel angular pressing (CECAP) process for producing ultrafine-grained mg alloy. Results studied through LSV and EIS. The findings revealed that the sample processed at 275°C with a production rate of 15 mm/min demonstrated the best corrosion resistance because of finer grain structure compared to the other samples in SBF. The current density of corrosion for this sample was measured at 1.66×10^{-4} A/cm^2, highlighting its superior performance.

Keywords: Mg alloys, Biomedical implants, Corrosion, SBF,CECAP

References

[1] M.P. Staiger, A.M. Pietak, J. Huadmai, G. Dias, Magnesium and its alloys as orthopedic biomaterials: a review, Biomaterials, 27 (2006) 1728-1734.

[2] M. He, L. Chen, M. Yin, S. Xu, Z. Liang, Review on magnesium and magnesium-based alloys as biomaterials for bone immobilization, Journal of Materials Research and Technology, 23 (2023) 4396-4419.

[3] F. Witte, J. Fischer, J. Nellesen, H.-A. Crostack, V. Kaese, A. Pisch, F. Beckmann, H. Windhagen, In vitro and in vivo corrosion measurements of magnesium alloys, Biomaterials, 27 (2006) 1013-1018.

Design and fabrication of a polishable triple electrode made by graphite rode and silver wire and its application in the electrochemical determination of azathioprine by drop-casting on the three-electrode system surface

Mehrdad Abbasi Mahmoudabad[a], Ali Rasi Mahmoudi[a], Karim Asadpour Zeynali[a*]

[a]*Department of Analytical Chemistry, Faculty of Chemistry, University of Tabriz, Tabriz, Iran*

[*]*E-mail: k.zeynali@gmail.com*

Background:
The three-electrode systems used in electroanalytical chemistry are mainly of two types: conventional and screen-printed electrodes (SPEs) [1]. Conventional systems require at least 2-5 mL of solution [2], which presents challenges for small volume cells. SPEs allow microliter volume analysis but they are disposable and cannot be polished for surface renewal. [3]. Very recently, another three-electrode system which called Polishable Triple Electrode (PTE) has been introduced [4]. This system combines the advantages of both SPEs and the conventional systems and overcomes the disadvantages of them.

Results:
This work introduces an inexpensive three-electrode system based on PTE for electrochemical determinations. It uses two pencil graphite plates as working and auxiliary electrodes, and a silver plate as a pseudo-reference electrode. All electrodes were connected to 3.5mm handsfree connector, embedded in a Teflon tube and filled with epoxy resin. System was used to analyze azathioprine (AZA) in tablet using differential pulse voltammetry. Parameters like buffer type and pH were optimized by drop-casting sample solution on the electrode surface. The method's linear range for AZA was 36-435 µM, with a detection limit of 20.6 µM.

Significance:
Advantages of this type of three-electrode include immersion and drop-casting analysis, low cost, renewable electrode surface, and ease of use. The compact design supports miniaturization for portable devices. This electrode combines the benefits of conventional systems and SPEs, offering low cost, reusability, and electrochemical cell formation with microliter volumes. These advantages are especially important for forensic or expensive biological samples.

Keywords: Electrode fabrication, Micro-volume cell, Polishable triple electrode, Azathioprine

References

[1] S. Ghorbanzadeh, S.M. Naghib, A. Sadr, F. Molaabasi, W. Zhang, Frontiers in Bioengineering and Biotechnology, 10 (2022).
[2] N. Vishnu, C.S. Sharma, A. Senthil Kumar, Microchemical Journal, 159 (2020) 105591.
[3] B. Pérez-Fernández, A. Costa-García, A. de la E.- Muñiz, Biosensors, 10 (2020) 32.
[4] M. Abbasi, A. Rasi Mahmoudi, K. Asadpour-Zeynali, Sensing and Bio-Sensing Research, 43 (2024) 100635.

Synthesis, characterization, and application of $NiMn_2O_4$/CQD nanocomposite for electrochemical determination of chloramphenicol in pharmaceutical and clinical samples

Salva Golparvar Nobari[a]*, **Karim Asadpour Zeynali**[a]

[a]*Department of Analytical Chemistry, Faculty of Chemistry, University of Tabriz, Tabriz, Iran*

**E-mail:* salvagolparvar@gmail.com

Chloramphenicol (CAP) is a versatile antibiotic employed extensively in treating bacterial infections in both human and veterinary medicine [1]. However, its widespread use comes with potential risks due to its chemical structure. The presence of a nitrobenzene group in CAP contributes to its toxicity [2]. Excessive use of this antibiotic can result in severe health complications, particularly irreversible damage to the bone marrow, which may progress to life-threatening aplastic anemia [3]. Given these serious health concerns, there is a pressing need to develop accurate and sensitive detection methods for CAP. Such sensors would be crucial for monitoring CAP levels in pharmaceutical preparations and human blood samples, thereby enhancing patient safety and public health [4].

In this study, a $NiMn_2O_4$ spinel/carbon quantum dot ($NiMn_2O_4$/CQD) nano composite was employed to modify a glassy carbon electrode surface. Various techniques, including Fourier transform infrared spectroscopy (FT-IR), X-ray diffraction (XRD), Scanning electron microscopy (SEM), and Energy-dispersive X-ray spectroscopy (EDX), were utilized to confirm synthesis and determine the structure of $NiMn_2O_4$/CQD. Cyclic voltammetry and differential pulse voltammetry were used to examine electrochemical behavior and measure CAP on the modified electrode. Parameters affecting analytical efficiency such as pH and buffer type were optimized. The modified electrode demonstrated effective electrochemical behavior for CAP determination, exhibiting a linear response range of 0.5-143 μM and a detection limit of 470 nM. These results signify a marked improvement in sensitivity and accuracy for determination of CAP in Pharmaceutical and Clinical Samples.

Keywords: Chloramphenicol, $NiMn_2O_4$/CQD composite, Voltammetry, Antibiotic detection, Electrochemical sensor

References

[1] J. Lin, K. Zhang, L. Jiang, J. Hou, X. Yu, M. Feng, C. Ye, Science of The Total Environment, 850 (2022)
[2] P.L. Páez, M.C. Becerra, I. Albesa, Basic & Clinical Pharmacology & Toxicology, 103 (2008) 349–353.
[3] Z. Alam, T. Coyle, Blood, 136 (2020) 4–5.
[4] N. Karikalan, A. Yamuna, T.Y. Lee, Analytica Chimica Acta, 1243 (2023) 340841.

A sensitive nonenzyme hydrogen peroxide sensor based on a chitosan/palladium nanoparticles@carbon quantum dots nanocomposite

Farzad Allahnouri[ad], Khalil Farhadi[ab]*, Hamideh Imanzadeh[c] , Elham Alambarkat[d] ,Masoud Allahnouri[e]

[a] Department of Analytical Chemistry,Faculty of Chemistry,Urmia University,Urmia, Iran
[b] Institute of Nanotechnology, Urmia University, Urmia, 5756151818, Iran
[c] Department of Plant Sciences and Medicinal Plants, Meshgin-shahr Faculty of Agriculture, University of Mohaghegh Ardabili, Ardabil, Iran
[d]South pars Gas comlex,asaluyeh, Iran
[e]Faculty of Dentistry, Ilam University of Medical Sciences, Ilam, Iran

*E-mail: *Khalil.farhadi@yahoo.com**

Abstract

Hydrogen peroxide (H_2O_2) is one of the most important analytes, widely used as universal oxidizing agent in industrial, chemical, pharmaceutical, clinical, and environmental fields. It is also a very important intermediate in environmental and biological reactions. The extensive use of H_2O_2 may have an adverse effect on the environment [1]. The H_2O_2 enters the human body; it accelerates human cell carcinogenesis and increases the risk of cancer [2]. Therefore, accurately monitoring the concentration level of H_2O_2 is critically important in many fields especially health care and food industry. Herein, we prepared new nonenzyme chitosan/palladium nanoparticles@carbon quantum dots nanocomposite (CHIT/Pd@CQDs NCs) to construct an electrochemical nanosensor for the highly sensitive detection of H_2O_2. The electrochemical properties of CHIT/Pd@CQDs NCs/screen-printed carbon electrode (SPCE) were investigated by cyclic voltammetry and amperometry techniques. The prepared nanocomposite electrode exhibited high electrochemical activity for the detection of hydrogen peroxide (H_2O_2) in Britton-Robinson (B-R) buffer solution at an applied potential of -0.3 V, showing a linear dependence on the concentration of H_2O_2 from 0.5 μM to 3280 μM, a high sensitivity, and a detection limit of 0.2 μM (signal/noise = 3). The nanosensor also showed a stable and reproducible response with insignificant interference from the electroactive organic and inorganic species. Furthermore, the as-prepared CHIT/Pd@CQDs NCs/SPCE was illustrated in milk to detect H_2O_2, demonstrating that the fabricated nanosensor has a promising potential application in the food industry.

References

[1] Alemayehu, D., Bitew, Z., & Yohannes, Y. B.."Development of a new electrochemical sensor based on nafion/cobalt doped bismuth ferrite nanoparticle modified glassy carbon electrode for detection of hydrogen peroxide." Sensing and Bio-Sensing Research 42 (2023): 100586.

[2] Mohammad, A., & Zamzami, M. A., "Construction of carbon cloth modified-Al2O3-g-C3N4 sensor for non-enzymatic electrochemical detection of hydrogen peroxide." Diamond and Related Materials 132 (2023): 109600.

Molecularly Imprinted Polymer Supported CoS/MoS_2-Derived MOF for Electrochemical Detection of Cortisol Biomarker

Zahra Ejraei[a], Mahsa Kalhori[a], Kheibar Dashtian[a]*, Rouholah Zare-Dorabei[a]

[a] *Department of Chemistry, Iran University of Science and Technology, Tehran, Iran*

**E-mail: kdastht68@gmail.com, mhsa.kalhori@gmail.com*

Abstract

Cortisol is a key biomarker for monitoring health, mental status, and stress-related disorders in the human body [1]. In this study, we prepared CoS_2/MoS_2/C composite, derived from a Polyoxometalate-based Metal-Organic Framework (MOF), known as NENU-5, as a robust catalytic support. The prepared composite was integrated with gold nanoparticles as bridging agent for a coupling of polydopamine-based molecularly imprinted polymer (MIP) for the electrochemical detection of cortisol in human sweat [2]. Electrochemical, scavenging, fluorescent, and physicochemical properties of the prepared samples revealed that the synergistic effects of Co and Mo within CoS_2/MoS_2/C, combined with the selectivity of the molecularly imprinted polymer (MIP), significantly enhance the catalytic. This improvement is attributed to the promotion of redox cycling and Fenton-like reactions, along with an accelerated electron transfer rate, which collectively boost overall catalytic performance. The synthesized nanozyme demonstrated remarkable sensitivity (2.9 μA/nM), with a limit of detection (LOD) of 35 nM and a limit of quantification (LOQ) of 119 nM in the linear dynamic range (LDR) equal to 0.1–250 μM using differential pulse voltammetry technique, making it highly suitable for diagnostic of cortisol in humane sweat samples. We expect that our proposed materials will provide a suitable candidate to design electrochemical sensors with high accuracy and reliability for in situ and real-time monitoring of human sweat biomarkers, not just cortisol.

Keywords: Electrochemical sensor, Bimetal-organic framework, Cortisol biomarker, molecularly imprinted polymer

References

[1] Karuppaiah, Gopi, Min-Ho Lee, Shekhar Bhansali, and Pandiaraj Manickam. Biosensors and Bioelectronics (2023): 115600.

[2] Mei, Xuecui, Jiao Yang, Xinge Yu, Zhengchun Peng, Guanghui Zhang, and Yingchun Li. Sensors and Actuators B: Chemical 381 (2023): 133451.

Dual-Metal-organic frameworks (Ce/V MOF) based nanozyme for electrochemical detection of L-Serine biomarker

Arezoo Esmaeili[a], Mahsa Kalhori[a], Kheibar Dashtian[a]*, Rouholah Zare-Dorabei[a]

[a] Department of Chemistry, Iran University of Science and Technology, Tehran, Iran

**E-mail: kdastht68@gmail.com, mhsa.kalhori@gmail.com*

Abstract

The development of advanced nanozymes for sensing applications has attracted significant attention due to their potential to enhance sensitivity and selectivity in detecting biomarkers for real-time disease monitoring [1]. Herein, we synthesized a multi-redox bimetal-organic framework, UiO-66-NH_2(Ce/V), using a straightforward hydrothermal method for the electrochemical detection of L-serine, an essential biomarker involved in various metabolic pathways [2]. Electrochemical, scavenging, fluorescent, and physicochemical characterizations revealed that the synergistic effect of Ce and V within UiO-66-NH_2 significantly boosts catalytic activity. This enhancement is achieved by promoting redox cycling and Fenton-like reactions, alongside an accelerated electron transfer rate, which collectively improve the nanozyme's overall performance. The synthesized nanozyme exhibited outstanding sensitivity (19.1 µA/nM) with a limit of detection (LOD) of 14 nM and a limit of quantification (LOQ) of 49 nM, in the linear dynamic range (LDR) equal to 0.1–300 µM using differential square wave voltammetry technique making it highly suitable for diagnostic of L-serine in humane saliva samples. The MOF exhibited remarkable selectivity and stability, enabling reliable detection in saliva samples. This innovative nanozyme platform paves the way for the development of efficient and robust electrochemical sensors, ideally suited for point-of-care diagnostic applications.

Keywords: Electrochemical sensor, Nanozymes, Bimetal-organic framework, L-serine biomarker

References

[1] Hu, W. C., Pang, J., Biswas, S., Wang, K., Wang, C., & Xia, X. H. Analytical Chemistry, 93(24), (2021) 8544-8552.

[2] Doran, Michelle M., Kobi P. Bermingham, Mark D. Tricklebank, and John P. Lowry. Talanta 278 (2024) 126458.

A Flexible magnetic electrode based on electrochemical coating of cobalt and iron nanoparticles on the PVP.rGO/polyester fabric

Soraya Ghayempour[a]*, Zahra Zare Zardeini[a], Mohammad Mazloum-Ardakani[b]

[a]*Department of Textile Engineering, Faculty of Engineering, Yazd University, Yazd, Iran*

[b]*Department of Chemistry, Faculty of Science, Yazd University, Yazd, Iran*

**E-mail: s.ghayempour@yazd.ac.ir*

Abstract: Today, the technology's advancements related to the textiles coated with magnetic nanoparticles have been interested by researchers according to their properties such as conductivity, magnetic property, flexibility, and strength. Magnetic textiles are widely used in the fabrication of supercapacitors, temperature and pressure sensors, filters, magnetic scaffolds, and others [1-3]. The aim of this research is to prepare magnetic polyester (PE) fabric through the electrochemical coating of cobalt and iron nanoparticles. Conducting the PE fabric surface was done through a two-step process including immersion in a solution containing polyvinylpyrrolidone (PVP) and reduced graphene oxide (rGO) and then annealing at 60 ˚C for 10 minutes. Electrochemical coating of cobalt nanoparticles on the surface of PVP.rGO/PE was carried out using a three-electrode system including Ag/AgCl electrode as a reference electrode, platinum electrode as the counter electrode, and PVP.rGO/PE as the working electrode immersed into a solution containing $Co(NO_3)_2.6H_2O$ and KCl followed by applying a constant potential of -0.9 V for 100 seconds. Iron nanoparticles were deposited on Co/PVP.rGO/PE surface using a solution containing $K_3Fe(CN)_6$ and KCl at a constant potential of 0.9 V for 100 seconds. Scanning electron microscopy (SEM) images and Fourier-transform infrared spectroscopy (FTIR) spectra indicated the successful synthesis and stabilization of Cobalt and iron nanoparticles on the surface of conductive PE textile. Also, the electrochemical behavior of the prepared electrode was evaluated by cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS).

Keywords: Electrochemical coating, Reduced graphene oxide, Conductive electrode, Polyester fabric, Magnetic nanoparticles

References

[1] L. Wang, X. Fu, J. He, X. Shi, T. Chen, P. Chen, B. Wang and H. Peng, *Advanced Materials*, 32 (2020) 1901971.
[2] X. M. Bian, L. Liu, H. B. Li, C. Y. Wang, Q. Xie, Q. L. Zhao, S. Bi, Z. L. Hou, *Nanotechnology*, 28 (2016) 045710.
[3] N. M. Kamal, H. K. Egzar, N. A. S. Ridha, *EurAsian Journal of BioSciences*, 14 (2020) 3595.

Electrocatalytic performance of the green synthesized α-Fe2O3 for determination of 2-Nitrophenol

Mir Hadi Banan Khojasteh[a*], **Aynaz Kamyab**[b], **Ali Rasi Mahmoudi**[c], **Karim Asadpour Zeynali**[d*]

[a] *Department of Analytical Chemistry, Faculty of Chemistry, University of Tabriz, Tabriz 5166616471, Iran*

[*] *E-mail: k.zeynali2@gmail.com, mirhadibanan@gmail.com*

Abstract

Analyzing 2-Nitrophenol is crucial due to its environmental and health impacts. It is a toxic pollutant found in industrial waste, affecting water and soil quality. Accurate analysis helps in monitoring pollution levels, ensuring compliance with environmental regulations, and developing effective remediation strategies [1,2].

In this research work, an environmentally friendly electrochemical sensing assay has been developed by using α-Fe2O3 for the highly sensitive and selective determination of 2-Nitrophenol in various samples. At first, α-Fe2O3 has been synthesized from Turmeric, then the obtained α-Fe2O3 was dispersed in water and deposited on a glassy carbon electrode (GCE) by the dropping method. Then electrochemical methods differential pulse voltammetry and cyclic voltammetry (DPV and CV) have been applied for sensitive determination and characterization of the 2-Nitrophenol. Moreover, electrochemical impedance spectroscopy (EIS) has been also used for approving the obtained cyclic voltammetry consequences. For confirming the successful synthesis of the α-Fe2O3, various characterization methods including FE-SEM, EDS, XRD, FTIR, and BET have been utilized. After the plotted the calibration diagram with the DPV technique, the detection limit, and the linear range were calculated for 2-nitro phenol. Therefore, the method is sensitive, simple, and specific with a short analysis time, and the main advantages of this sensor are an easy and green synthesis route, low detection limit, excellent stability, repeatability, and good selectivity in 2-Nitrophenol. One of the successes of this sensor is in determining 2-Nitrophenol in tablets, human plasma samples.

Keywords: Differential pulse voltammetry, Glassy carbon electrode, 2-Nitrophenol, Electrochemical sensor, α-Fe2O3

References

[1] Bilal, Muhammad, Ahmad Reza Bagheri, Pankaj Bhatt, and Shaohua Chen. "Environmental occurrence, toxicity concerns, and remediation of recalcitrant nitroaromatic compounds." Journal of Environmental Management 291 (2021): 112685.

[2] Thakur, Abhinay, and Ashish Kumar. "Recent advances on rapid detection and remediation of environmental pollutants utilizing nanomaterials-based (bio) sensors." Science of The Total Environment 834 (2022): 155219.

Fabrication of impedimetric sensor based on Bio-MOF/Au NPs nanocomposite for the determination of Ciprofloxacin

Samaneh Ebadi[a], Khadijeh Ghanbari[a]*
[a]Department of Analytical Chemistry, Faculty of Chemistry, Alzahra University, P. O. Box 1993893973, Tehran, Iran
**E-mail: kh.ghanbari@alzahra.ac.ir*

Abstract

In this study, the biological metal-organic framework (Bio-MOF) was successfully synthesized with organic and biological organic compounds (as ligands), and metal. Bio-MOF was used as a new nanocomposite for designing and constructing carbon paste electrodes (CPE). The designed electrode of the CPE/Bio-MOF electrode was modified by Au nanoparticle and introduced as a susceptible sensor for Ciprofloxacin determination. The CPE/ Bio-MOF/Au Nps sensor was studied by cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). The CPE/ Bio-MOF/Au Nps sensor provided an 11-fold increase in the signal of the redox probe of $Fe\ (CN)_6^{3-/4-}$. The Ciprofloxacin can be detected with a minimum concentration of 0.12 μM. The standard deviation for five consecutive measurements was calculated as less than 3.5 % and linear range of 1μM-1000 μM. This modified electrode was used for simple and fast detection of ciprofloxacin in pharmaceutical and blood serum samples.

Background:

Ciprofloxacin (CIP) is one of the most important antibacterials for the treatment of infections of sinuses, bones, typhoid fever, prostate, lung, and bladder [1]. It provides an effective treatment [2] but it can remain undegradable in the human or animal body. Therefore, there is a high possibility that it is largely excreted as an active compound in serum and plasma or enters the environment through the urine samples of patients. The presence of CIP in natural is the origin of toxic activities even at low concentration levels [3]. This work aimed to develop a simple, sensitive, and reliable method for the determination of ciprofloxacin in tablet and blood serum.

Results:

A carbon paste electrode was modified by Bio-MOF and Au nanoparticle. So, an electrochemical sensor of CPE/Bio-MOF/Au NPs was designated. The electrochemical behavior of CIP was investigated by CV and impedance in the presence of a redox probe $Fe\ (CN)_6^{3-/4-}$. The CPE/Bio-MOF/Au NPs sensor indicated a significant current increase of nearly 11-fold compared to the bare CP electrode. The FE-SEM method was used to study the morphology of Bio-MOF and Bio-MOF/Au NPs. To evaluate the designed sensor was used for the measurement of CIP in biological samples of tablets and blood serum.

Significance:

In our current work, we propose a sensor using Bio-MOF/AuNps for measuring CIP at micromolar concentrations. Therefore, the CPE/Bio-MOF/Au Nps sensor effectively detects CIP in biological samples such as blood serum and tablets

.

Keywords: Bio-MOF, Au nanoparticle, Ciprofloxacin, Impedimetric sensor

References

[1] M. Azriouil, M. Matrouf, F. E. Ettadili, F. Laghrib, A. Farahi, S. Saqrane, M. Bakasse, S. Lahrich and M. A. El Mhammedi, *Food and Chemical Toxicology*, 168 (2022) 113378.
[2] R. Mirzajani, A. Keshavarz, *Journal of the Iranian Chemical Society*, 16(2019) 2291-2306.
[3] A. Wong, A. M. Santos, T. A. Silva, F. C. Moraes, O. Fatibello-Filho and M. D. P. T. Sotomayor, *Electroanalysis*, 35(2023) e202200165.

Electrochemical Corrosion Under Radioactive Irradiations

Mojtaba Bagherzadeh*
Reactor and Nuclear Safety Research School, Nuclear Science and Technology Research Institute, 81465-1589, Tehran, Iran.
**E-mail mjmo123@yahoo.com*

Abstract: The impact of radioactive radiation, gamma rays, and neutrons on corrosion in aqueous environments is a topic of significant importance [1]. In the such aqueous environments, radiolysis reactions and the release of electrochemically active species H_2, $HO^{\bullet}$, $H^{\bullet}$, $HO_2^{\bullet}$, H_3O^+, OH^-, H_2O_2 and, e_{aq}^- greatly influence the electrochemical phenomena involved in corrosion [2]. While efforts have been made to minimize corrosion in radiation environments through the selection of corrosion-resistant materials and continuous monitoring and control of the water environment in nuclear reactors, there is a need for ongoing research to monitor and test new materials [3]. The presence of high-energy gamma rays and neutrons presents numerous challenges for researchers, including the selection of suitable and radiation-resistant reference electrodes and the consideration of radiation safety. This presentation will delve into the reactions involved in electrochemical corrosion, the requirements for choosing electrodes, and provide an example of research conducted in this field.

Keywords: Irradiation Corrosion, Reference electrode, electrochemical corrosion potential (ECP).

References

[1] F. Schmidt, P. Hosemann, R.O. Scarlat, D.K. Schreiber, J.R. Scully, B.P. Uberuaga, Annu. Rev. Mater. Res. 51(1) (2021) 293.
[2] S. Le Caër, Water. 3(1) (2011) 235.
[3] M. Bagherzadeh, M. Karimi, M.H. Choopan Dastjerdi, M. Asadi Asadabad, J. Mokhtari, A. Babanejhad, Sci. Rep. 13(1) (2023) 17007.

High-performance Energy Storage Systems Constructed from Highly Porous Tri-metallic Metal-Organic Frameworks and Low-priced Biomass-derived Carbons

Farzaneh Hekmat[a]*
[a]*Department of Chemistry, Faculty of Chemistry and Petroleum Science, Shahid Beheshti University (SBU), Tehran 1983969411, Iran*

E-mail: f_hekmat@sbu.ac.ir

Abstract: Since renewable and clean energy demands continue to rise, development of high-performance energy storage systems is of special significance in recent years. Harnessing benefits from both high energy and power densities parallel to long-term cycle stability, increasing attention has been drawn by supercapacitors (SCs) [1]. Among a variety of materials have been utilized as electrode active materials, metal organic frameworks (MOFs) with adjustable specific surface area and electric conductivity sound potent as high-performance electrode materials for SCs. Not only promoted network stability but also multiple oxidation states makes mixed metallic MOFs (MM-MOFs) ideal candidates for developing high-performance SCs [2]. With rapid energy discharging and high power density, porous carbons (PCs) seem promising as negative electrodes in hybrid SCs (H-SCs). Biomass-derived carbons (BCs) with their adjustable porosity, large specific surface area, promising conductivity, and high chemical/electrochemical stability have drawn attention in developing high-performance low-cost electrodes for SCs [3]. Herein, high-performance Ni-Co-Zn MOF cathodes were directly decorated onto the current collector via a one-pot hydrothermal process. Highly-porous carbon anodes were prepared via a one-step carbonization route. The prepared electrodes were then utilized in fabricating high-performance H-SCs.

Results: As reflected in Fig. 1a, FE-SEM images provide evidence on successful synthesis of tri-metallic MOFs onto the substrate. The electrochemical performance of the fabricated devices was investigated and the corresponding results are shown in Fig. 1b-d.

Significance: The fabricated H-SCs exhibited remarkable electrochemical performance, including high specific capacity, reasonable rate capability, as well as remarkable cycle durability, all of which showed the potential of prepared devices as high-performance energy storage systems.

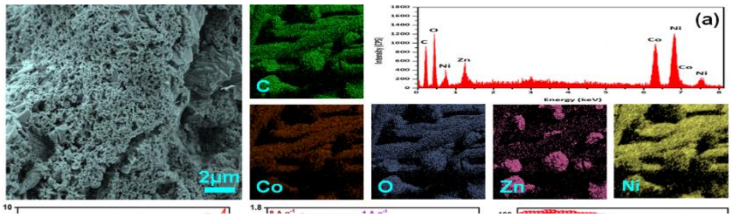
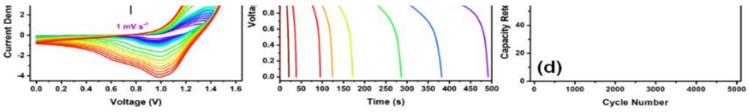


Figure 2. SEM images of (a) cathodes with corresponding EDS mapping results, electrochemical characterization of the fabricated H-SCs (b) CVs, (c) GCD, and (d) stability.



Keywords: Hybride Supercapacitors, Metal Organic Frameworks, Biomass-derived Carbons

References

[1] F. Hekmat, M. Shahi, D.P. Dubal, S. Shahrokhian, *Sustain. Energy Fuels.* 6 (2022) 3042–3055.

[2] P.C. Banerjee, D.E. Lobo, R. Middag, W.K. Ng, M.E. Shaibani, M. Majumder, *ACS Appl. Mater. Interfaces.* 7 (2015) 3655–3664.

[3] H. Sharifpour, F. Hekmat, S. Shahrokhian, *ACS Appl. Mater. Interfaces.* 15 (2023) 42568–42584.

Electrochemical Investigation of Zr-Nb 1% Alloy Corrosion Under Irradiation

Maryam Saeedi Rad[a], **Mojtaba Bagherzadeh**[b]*, **Abolfazl Semnani**[a], **Javad Mokhtari**[b]
[a]*Department of Chemistry, Faculty of Science, University of Shahrekord, Shahrekord, Iran.*

[b]*Reactor and Nuclear Safety Research School, Nuclear Science and Technology Research Institute, 81465-1589, Tehran, Iran.*
[*]*E-mail maryamsaidirad5@gmail.com*

Abstract: Irradiation corrosion studies play a crucial role in understanding the impact of radiation on the corrosion behavior of materials utilized in nuclear reactors [1,2]. This understanding is essential for ensuring the safety and reliability of nuclear power plants and other facilities exposed to radiation [3]. Herein, corrosion behaviour of Zr-Nb 1% alloy under irradiation at different doses of radiation using a research nuclear reactor through electrochemical methods was reported. The study aims to understand the impact of radiation on the corrosion of the alloy in D_2O, H_2O, and 3.5% NaCl environments. The electrochemical techniques including CV, LSV, and Tafel polarization were employed to analyse the corrosion behaviour under both non-radiated and radiated conditions at the maximum power of the reactor. The findings of the study indicate that the presence of neutron radiation, high-energy nuclear rays, and aggressive ions significantly influence the corrosion behaviour of the Zr-Nb 1% alloy. The results show that under reactor-on conditions, the corrosion current density (J_{corr}) was highest, attributed to the combined effects of neutron radiation, high-energy particles, and alteration of the aqueous environment chemistry. Additionally, the presence of chloride ions in the 3.5% NaCl solution further accelerated the corrosion rate (*CR*) under reactor-on conditions. Furthermore, the study observed a decrease in both J_{corr} and *CR* under reactor-off conditions, indicating the impact of high-energy radiation and radicals generated by water radiolysis in the absence of high neutron radiation flux. These findings offer significant understanding of the corrosion characteristics of Zr-Nb 1% alloy when subjected to irradiation.

Keywords: Irradiation Corrosion, Zr-Nb 1% Alloy, Tafel, Radiolysis.

References

[1] F. Schmidt, P. Hosemann, R.O. Scarlat, D.K. Schreiber, J.R. Scully, B.P. Uberuaga, Annu. Rev. Mater. Res. 51(1) (2021) 293.
[2] S. Swaminathan, K. Sun, G.S. Was, J Nuc. Mater. 585 (2023) 154604.
[3] M. Bagherzadeh, M. Karimi, M.H. Choopan Dastjerdi, M. Asadi Asadabad, J. Mokhtari, A. Babanejhad, Sci. Rep. 13(1) (2023) 17007.

Fabrication of an electrochemical sensor using a screen printed electrode modified with molecularly imprinted polymers for the simultaneous measurement of two drugs, Siponimod and Teriflunomide.

Mansoura Alighiyan Bagh khandan, Ali Benvidi*, Emadaddin Amin Sadrabadi

[a]*Department of Chemistry, Faculty of Chemistry, Yazd University, Yazd, Iran*

**E-mail: abenvidi@yazd.ac.ir; benvidi89@gmail.com*

Abstract

Multiple sclerosis (MS) is an autoimmune disease in which the insulating covers of nerve cells in the brain and spinal cord are damaged. Being a demyelinating disease, MS disrupts the ability of parts of the nervous system to transmit signals [1].

Siponimod is a selective sphingosine-1-phosphate receptor modulator that is used for multiple sclerosis (MS). Side effects of Siponimod include headache, high blood pressure, and liver function test abnormalities [2].

Teriflunomide is the active metabolite of leflunomide. Teriflunomide is used as a medicine for MS. Side effects of Teriflunomide include skin complications, increased blood pressure, risk of stroke [3].

Since the monitoring of drug metabolism and drug levels in plasma plays an important role in human health, it is important to develop easy, accurate and sensitive methods for the detection of effective agents. Various methods have been devised to measure these two drugs in biological samples.

In 2017, an edge plane pyrolytic graphite electrode was used for the determination of Teriflunomide in Kinga Kaczmarska's article [4].

In this research, screen printing electrodes modified with molecular imprinted polymers were used for the simultaneous determination of Siponimod and Teriflunomide. Due to point of care, reduction of chemicals, wider linear range and simultaneous measurement of two drugs, it was more efficient and advantageous than the previously mentioned methods.

Keywords: Multiple sclerosis, Teriflunomide, Siponimod, Screen printing electrodes, Molecular imprinted polymers

References

[1] A. Compston and A. Coles, *The Lancet*, *372* (2008) 1502.
[2] L. Kappos, A. Bar-Or, B. Cree, R. Fox, G. Giovannoni, R. Gold, P. Vermersch, E. Lam, H. Pohlmann and E. Wallström, *Multiple Sclerosis and Related Disorders*, *3* (2014) 752.
[3] D. Magne, F. Mézin, G. Palmer and P. A. Guerne, *Inflammation Research*, *55* (2006) 469.
[4] K. Kaczmarska, M. Brycht, A. Leniart and S. Skrzypek, *RSC advances*, 7 (2017) 26028.

Multi-walled carbon nanotubes and silicon carbide nanoparticles modified platinum electrode for detection of dasatinib

Amin Danesh-Ungut[a], Habibollah Eskandari[a]*, Eslam Pourbasheer[a]

[a]*Department of Chemistry, Faculty of Basic Sciences, University of Mohaghegh Ardabili, Ardabil, Iran*

**E-mail: h_eskandari2001@yahoo.com*

Abstract

Background:

Dasatinib, a tyrosine kinase inhibitor, is used to treat a variety of cancers, including leukemia and prostate cancer. Due to the increasing application of dasatinib and also the leakage of the chemical in the environment, it seems necessary to develop efficient sensing methods for dasatinib monitoring in biological fluids and environment [1].

Results:

A platinum electrode was modified by a mixture of multiwalled carbon nanotube and silicon carbide nanoparticles (Pt/MWCNTs/SiC). The cyclic voltammetry of dasatinib on the modified electrode showed that an irreversible behavior when dasatinib is oxidized. The oxidation peak was observed in the range of +0.75-1.00 V (against Ag/AgCl) at pH equal to 5.6 (acetic acid/sodium acetate). The modified electrode was employed in order to detect dasatinib by square wave voltammetry.

The effective parameters such as pH and amounts of the modifiers were optimized, and potential of the sensing method was investigated (for successful assaying of dasatinib in biological and environment samples). Under the optimum condition, a linear dynamic range of 0.03-3.5 μmol L^{-1} was found for dasatinib by square-wave voltammetry. Also, limit of detection equal to 7.0 nmol L^{-1} was found for dasatinib.

Significance:

Various foreign species including amino acids, carbohydrates, anions and cations were tested for evaluating the selectivity of the method. Dasatinib in urine, plasma, soil and water samples was successfully analyzed by the developed method. Some advantages on linear dynamic range, limit of detection and types of the analyzed samples were observed against some of the other previously reported methods.

Keywords: Dasatinib, Multiwalled carbon nanotubes, Silicon carbide nanoparticles, Square-wave voltammetry.

References

[1] V. Chau, R. A. Madan and J. B. Aragon-Ching, *Expert Opinion on Pharmacotherapy*, 22 (2021) 1889.

Adsorptive electrochemical detection of o-tolidine by super conductive carbon black nanoparticles modified platinum electrode

Sayyed Milad Amini[a], Habibollah Eskandari[a]*

[a]Department of Chemistry, Faculty of Basic Sciences, University of Mohaghegh Ardabili, Ardabil, Iran

E-mail: h_eskandari2001@yahoo.com

Abstract

Background:

o-Tolidine is an aromatic diamine compound which has been employed to prepare some azo dyes. The compound is carcinogenic for humans. Due to the widespread applications of o-tolidine and its hazards, detection of the o-tolidine residues in the environment is necessary in viewpoint of the human health [1].

Results:

In this work, a platinum electrode was modified by carbon black nanoparticles (Pt/CBNs) and was used for the determination of o-tolidine employing an adsorptive method. The electrode showed a reversible behavior. A diazotization approach (as a chemical reaction prior to the adsorptive differential pulse voltametric detection) was conducted to convert the amino groups of o-tolidine to hydroxy groups. In this manner, the sensitivity of the o-tolidine detection was enhanced. After that, in order to increase the sensitivity, some affective parameters such as pH, amount of the modifier and the accumulation period were optimized. Under the optimum condition, the linear range for o-tolidine detection was obtained to be 10 to 160 nmol L^{-1}. Also, the limit of detection was found to be 0.7 nmol L^{-1}. The effective area of Pt/CBNs was also measured.

Significance:

Various foreign species including organic chemicals, anions and cations were tested for evaluating the selectivity of the method. o-Tolidine in soil and water samples was successfully analyzed by the developed method. Some advantages on linear dynamic range, limit of detection, sensitivity and selectivity were observed against some of the other previously reported methods.

Keywords: o-Tolidine, Super conductive carbon black nanoparticles, Differential pulse voltammetry.

References

[1] Y. Tajima, T. Toyoda, Y. Hiroyama, K. Matsushita, T. Yamada, K. Ogawa, K. Watanabe, T. Takamura-Enya, Y. Totsuka, K. Wakabayashi and N. Miyoshi, *Chemical Research in Toxicology*, 33 (2020) 1907.

Molybdenum doped $BiVO_4$ sensing platform for photoelectrochemical detection of uric acid

Mina-Sadat Koshki[a], Sahra Khosrojerdi[a], Mehdi Baghayeri[a,*], Sirous Salemi [a,*], Mohammad Zirak[b]

[a]*Department of Chemistry, Faculty of Science, Hakim Sabzevari University, Sabzevar, Islamic Republic of Iran*

[b]*Department of Physics, Faculty of Science, Hakim Sabzevari University, Sabzevar, Islamic Republic of Iran*

[*]*E-mail: m.baghayeri@hsu.ac.ir (Mehdi Baghayeri),*

s.salemi@hsu.ac.ir

Background:

Uric acid (UA) has been considered a major metabolic product of the human body. It has been recognized that uric acid levels can provide evidence for disease diagnosis and health care with respect to illnesse, hypertension, cholesterol levels, heart diseases [1-3]. However, several problems still remain regarding the efficiency and rapidness of the detection method. For this purpose, we presented a photoelectrochemical(PEC) Mo doped $BiVO_4$ sensor for detection of UA acid.

Experimental section

Fabrication of ITO/Mo doped $BiVO_4$ thin film

At first, synthesis of the precursor solution was performed according to our previous work [4]. Then, 1 ml of Mo doped $BiVO_4$ solution was hot spin coated on the clean ITO glasse electrode surface and allowed to dry in a oven. The fabricated photoelectrode was used for PEC tests.

Results

The carrier electrolytes and the pH of the electrolyte significantly impact the photocurrent response of the electrode. Therfore, we examined the photocurrent intensity of photoanode using the chronoamperometry method in various electrolyte solutions (0.1M KCl, phosphate buffer (PBS), acetate buffer and $NaNO_3$), with and without the presence of the UA analyte (ΔJ). Followed by, we assessed the pH of the PBS electrolyte within the range of 6 to 9, finding that the optimal ΔJ occurred in the 0.1M PBS (pH 7.5) solution.

Significance

In this study, a ITO/ $BiVO_4$ photoelectrode was fabricated via a hot spin coat process for detection of uric acid. After optimizing the experimental conditions, the PEC sensor detected UA in 0.1M PBS (pH 7.5) electrolyte. As a result, PBS with pH 7.5 was selected as the suitable electrolyte.

Keywords: Photoelectrochemical (PEC), Molybdenum doped bismuth vanadate (Mo doped $BiVO_4$), Thin film, Uric acid, Sensor

References

[1] X. Ma, L. Deng, Z. Zou, Z. Pan, L. Feng, Z. Huang, Z. Liang, X. Liu, M. Li, Z. Su, H. Zheng, Novel portable photoelectrochemical sensor based on CdS/Au/TiO2 nanotube arrays for sensitive, non-invasive, and instantaneous uric acid detection in saliva, Talanta, 271 (2024) 125646.
[2] Y. Wang, Y. Tao, P. Hao, C. Li, M. Li, Y. Tan, D. Wang, An organic photoelectrochemical transistor based on the Fe-MOF@PANI/carbon fiber for uric acid detection, Journal of Materials Chemistry C, (2024).
[3] Chanchal, J.P. Singh, K. Jindal, M. Tomar, P.K. Jha, A novel photoelectrochemical based water splitting and uric acid biosensing using PLD grown In2Se3 thin films, Electrochimica Acta, 505 (2024) 144933.
[4] M.-S. Koshki, M. Zirak, M. Kazemi, H. Alehdaghi, M. Baghayeri, M. Nodehi, N. Rabiee, Molybdenum-doped BiVO4 thin films: Facile preparation via hot-spin coating method and the relationship between surface statistical parameters and photoelectrochemical activity, Chemosphere, 346 (2024) 140579.

Practical electrochemical anodic oxidation of isoniazid for late-stage functionalization

Farideh lotfipour [a], Davood Nematollahi[a,b]* ,Niloofar Mohamadighader[a*]

[a]Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran
[b]Planet Chemistry Research Center, Bu-Ali Sina University, Hamedan, Iran.
*E-mail: faridehlotfipour41@gmail.com

Abstract: This work is focused on the late-stage electrochemical functionalization of isoniazid (INH), a common antibiotic drug for the treatment of tuberculosis, and the synthesis of new sulfonylhydrazine derivatives. The synthesis of these compounds has been easily carried out in one pot through the electrochemical oxidation of INH in the presence of arylsulfinic acid (AS) derivatives in water/ethanol mixture under constant current conditions. Also, in this work, the electrochemical behavior of INH and synthesized compounds (SUH) with different electrochemical methods were fully investigated and the results were reported.

Background:

Sulfonylhydrazines are an important group of compounds with antibacterial, antifungal, anticancer, insecticidal activity and the ability to inhibit enzyme activity. Sulfonylhydrazines were first synthesized in the late 19th century from sulfonic acid and hydrazines [1-3].

Results:

The electrochemical oxidation of isoniazid in the presence of arylsulfinic acids as nucleophiles in water (phosphate buffer, pH: 2.0, c = 0.2 M)/ ethanol mixture has been investigated using cyclic voltammetry and constant current conditions. under these conditions, INHox reacts with SUH and some new organic compounds are synthesized by electrochemical method figure1.

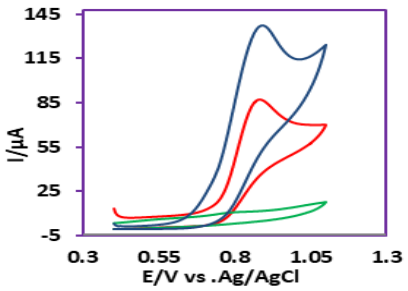


Figure 1. Cyclic voltammograms of 1 mmol INH in the presence of 2 mmol AS during constant current conditions. Ag/AgCl, in phosphate bufer (pH=2.0, c=0.2 M)/ ethanol mixture (50/50 v/v).

Significance:

In this work, we succeeded in synthesizing new derivatives of sulfonylhydrazine by galvanostatic method in conditions without catalyst and without chemical oxidant, using conventional electrochemical cells and electrodes, with good efficiency and purity.

Keywords: sulfonylhydrazine, Isoniazid, arylsulfinic acids.

References

[1] Ł. Popiołek, Biomedicine & *Pharmacotherapy* (2021) *141* 111851.

[2] H.H.S. Arkwazee, N. Mohamadighader, D. Nematollahi, A. Rabiee, H. Alizadeh, *Journal of The Electrochemical Society* 2022 *169*-075502.

Electrochemical late-stage modification of hydralazine. A green strategy for the synthesis of nano-structured new sulfonylhydrazine derivatives

Farideh Lotfipour,[a] **Davood Nematollahi,**[a, b*]

[a]Faculty of Chemistry and Petroleum Sciences, Bu-Ali Sina University, Hamedan, Iran

[b]Planet Chemistry Research Center, Bu-Ali Sina University, Hamedan, Iran

[*]E-mail: faridehlotfipour41@gmail.com

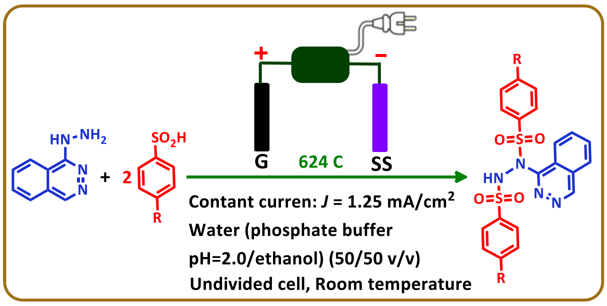
Abstract This work is focused on the electrochemical late-stage modification of hydralazine (1-hydrazinylphthalazine) (HYD). The synthesis of HYD derivatives has been easily accomplished in one-pot via electrochemical oxidation of HYD in the presence of arylsulfinic acid derivatives (ASA) in a water/ethanol mixture at constant current conditions.

Background:

The late-stage modification of drugs (LSMD) with the aim of synthesizing new drug derivatives with more potent activity than the parent drug has always been of interest to researchers. A lot of work has been done to synthesize new HYD derivatives, which is completely based on the nucleophilicity of HYD [1,2]. However, a literature survey reveals that unlike these reports no paper has reported the late-stage modification of HYD based on its electrophilicity. In this work, we were able to do this by changing the nature of HYD from nucleophile to electrophile.

Results:

The electrochemical results show that anodically generated 1-diazenylphthalazine (HYD_{ox}) reacts with arylsulfinic acids and converts into the corresponding sulfonylhydrazine derivatives (SHD) with high yield and purity in an undivided cell equipped with graphite anode and stainless steel cathode.



Scheme 1: Synthesis of **HYD** in the presence of **ASA**

Significance:

The main feature of this work is the synthesis of some new HYD derivatives in water/ethanol mixture as a "Green" reaction medium, using electrodes instead of toxic oxidants, having a high atom economy, having good energy efficiency and working at room temperature. These features are in accordance with the principles of green chemistry.

Keywords: Hydralazine, Late-stage modification ,Cyclic voltammetry.

References

[1] J. Zeng, M.J. Davies, *Chem. Res. Toxicol.* 19 (2006) 1668-1676.

[2] L.M. Kaminskas, S.M. Pyke, P.C. Burcham, *Org. Biomol. Chem.* 2 (2004) 2578-2584.

Corrosion behavior of laser cladded graphene nanoplatelets reinforced hydroxyapatite composite coatings on Ti-6Al-4V

Monireh Ganjali[a]*, Mansoureh Ganjali[b], Sorya Borna Zonoozi[a], Amin Sohrabi[a]
[a]*Department of Nanotechnology and Advanced Materials, Materials and Energy Research Center (MERC), Thran, Iran*

[b]*Nour-Zoha materials Engineering Research group, Tehran, Iran*

**E-mail: m.ganjali@merc.ac.ir*

Abstract

Background:
Titanium and its alloys are used in various industries. The high strength-to-weight ratio and good corrosion resistance of titanium and its alloys have led to the wide and diversified range of applications [1]. Meanwhile, Ti-6Al-4V is most widely used titanium alloy and one of the most important applications of this alloy is biomedical application and implants. Despite its desirable properties, its relatively poor wear resistance causes excessive wears and implant loosening [2]. In this study, in order to improve the wear resistance, Hydroxyapatite/Graphene nanocomposite was coated on Ti-6Al-4V by using Laser cladding technology.

Results:

- The hydroxyapatite/graphene nanocomposite coating was applied by laser cladding.
- The hydroxyapatite/graphene nanocomposite coating improves the corrosion resistance of the Ti-6Al-4V substrate.
-

Significance:
• *The reduced transport of electrons and ions between the* Ti-6Al-4V *substrate and SBF provided by laser treated* Hydroxyapatite/Graphene nanocomposite *barrier coating resulted in decreased electrochemical reaction and corrosion rate.*

Keywords: Titanium alloys, Laser cladding, Hydroxyapatite/Graphen nanocomposite, corrosion resistance

References

[1] G. He and M. Hagiwara, Ti alloy design strategy for biomedical applications, *Materials Science and Engineering: C*, 26, 2006, 14-19.
[2] Mo. Ganjali*, A. Ghalandarzadeh, Ma. Ganjali, *Surface Strategies and Classification of Biomaterials in book: Surface Engineering of Biomaterials*, CRC press, 2024

Survey of diverse variables on the micro-donning process of nanostructure coating nickel-graphene with direct current

Leila Mohammadi[a]*, **Mohammadreza Vaezi**[b]

[a, b] *Department of Nano Technology and Advanced Materials, Materials and Energy Research Center, Karaj, Iran.*
**E-mail:* l.mohammadi80@yahoo.com

Abstract

In this research, an attempt has been made to create a nickel-graphene nanostructure coating by direct current and using a nickel sulfamate bath, and the effect of various variables on the micro-denning process was investigated by X-ray diffraction pattern and Scherer Debye formula. Also, composite coating the nanostructure of Ni-Graphene is created by direct current. In the following, the effect of changes in parameters such as current density, temperature, time, pH and the amount of turbulence on the corrosion resistance, hardness, morphology and the amount of particles in the coating have been investigated [1].

Background:

- Recently, a new generation of metal-based composite coatings reinforced by nanometer ceramic particles has attracted the attention of researchers due to its good properties such as high hardness, wear resistance, and corrosion resistance [2].

- In this part, after presenting the results obtained according to the variable parameters, the results are discussed and a logical conclusion is presented. For this purpose, XRD and EDS analysis, FESEM and AFM microscopes, as well as a polarization device have been used.

- It is worth noting that based on parallel studies, this process is not permanent, and the increase in coating time also has limitations, and the corrosion resistance of the coating decreases from a higher value.

Keywords: nickel-graphene nanostructure, anti-corrosion, direct current, corrosion resistance

References

[1] A. Mahapatro and S. K. Suggu, Modeling and simulation of electrodeposition: Effect of electrolyte current density and conductivity on electroplating thickness. *Adv. Mater. Sci*, 3 (2018) 1.
[2] F. C. Walsh, S. Wang and N, Zhou, The electrodeposition of composite coatings: Diversity, applications and challenges. *Curr. Opin. Electrochem*, 20 (2020) 8-19.

Synthesis of metal modified aerogel and investigating its efficiency in electrochemical removal of tricyclazole pesticide from contaminated waters

Fatemeh Shirzadi[a], Mahmoud Zarei[a*]

[a]*Department of Applied Chemistry, Faculty of Chemistry, University of Tabriz, Tabriz, Iran*

[*]*E-mail: mzarei@tabrizu.ac.ir*

Abstract

Pesticides, including organophosphate compounds like tricyclazole, are widely used in agriculture and have been identified as significant environmental contaminants. These pollutants pose risks to aquatic ecosystems and human health due to their persistence and toxicity [1]. Conventional wastewater treatment methods often struggle to effectively remove pesticides, necessitating the development of advanced technologies. This study aimed to investigate the efficacy of a novel electro-Fenton-like system for the degradation of tricyclazole, a representative organophosphate pesticide [2]. A highly porous and uniformly structured carbon aerogel cathode electrode was successfully synthesized using the sol-gel method. The incorporation of metal particles enhanced the electrode's catalytic activity and promoted the generation of hydroxyl radicals during the electro-Fenton process. Experimental studies evaluated the impact of operational parameters, including pH, applied voltage, reaction time, and initial tricyclazole concentration, on the degradation efficiency. The results demonstrated the electrode's exceptional ability to degrade tricyclazole, with rapid and efficient removal observed under optimized conditions. The developed electro-Fenton-like system offers a promising solution for the removal of tricyclazole and other organophosphate pesticides from wastewater. The synthesized electrode's high stability, catalytic activity, and ability to produce harmless by-products make it a promising candidate for practical applications. This research contributes to the advancement of sustainable and effective water treatment technologies. The findings highlight the potential of electro-Fenton processes in addressing emerging environmental challenges associated with pesticide contamination.

Keywords: Pesticide, electro-Fenton-like, carbon aerogels, water purification

References

[1] H. Yu, D. Dou, X. Zhang, L. Zhang, H. Dong and H. Yu, Journal of Cleaner Production, 242 (2020) 118548.
[2] A. Babuponnusami, K .Muthukumar, Journal of Environmental Chemical Engineering, 2 (2014) 557-275.

Modification of carbon paste electrode to enhance electrochemical determination of 2,4,6-Trichlorophenol

Niloofar Nosratabadi*[a], **Hadi Beitollahi**[b], **Fariba Garkani Nejad**[b]

[a]Department of Chemistry, Faculty of Chemistry and Chemical Engineering, Graduate University of Advanced Technology, Kerman, Iran

[b]Environment Department, Institute of Science and High Technology and Environmental

Sciences, Graduate University of Advanced Technology, Kerman, Iran

**E-mail: niloofar.nosrati1376@gmail.com*

Abstract

2,4,6-Trichlorophenol (2,4,6-TCP) is one of the compounds that is extensively used in the production of fungicides, herbicides, and insecticides. Also, this compound is used as an intermediate material in various production processes, including the production of dyes, pigments, and medicines [1]. However, it can lead to the pollution of water bodies and is very harmful to human health. Therefore, in order to protect the environment and ensure human health, it is crucial to develop simple, fast, and sensitive analytical methods for the quantification of 2,4,6-TCP in environmental samples. Electrochemical techniques demonstrated good performances for the analysis of various compounds in environmental samples and biological fluids due to their advantages including cost-effective instruments, short analysis time, simplicity of operation, and high sensitivity [2]. In this work, two-dimensional metal-organic framework (2D Ni-MOF nanosheets) and graphene oxide (GO) modified carbon paste electrode (CPE) was applied to prepare an electrochemical sensing platform for determination of 2,4,6-TCP. The cyclic voltammetry (CV) studies revealed that the Ni-MOF nanosheets and GO modified CPE has a synergetic effect on the oxidation of 2,4,6-TCP. The designed sensor showed a linear response to 2,4,6-TCP in the 0.01 to 800.0 μM concentration range by using differential pulse voltammetry (DPV) with a low detection limit of 0.004 μM. Moreover, determination of 2,4,6-TCP in the water samples was investigated and good recoveries were obtained. Based on the good performance of the modified CPE, the prepared sensor possesses outstanding advantaged for determination of 2,4,6-TCP in the water samples.

Keywords: 2,4,6-Trichlorophenol, Carbon paste electrode, Electrochemical sensing platform, Environmental pollution.

References

[1] B. Arumugam, S. Palanisamy, G. Janagaraj, S.K. Ramaraj, M. Chiesa and C. Subramanian, *Surfaces and Interfaces*, 39 (2023) 102930.

[2] X. Zheng, S. Liu, X. Hua, F. Xia, D. Tian and C. Zhou, *Electrochimica Acta*, 167 (2015) 372-378.

Determination of tryptophan using differential pulse voltammetry with screen printed electrode with graphite carbon nitride (g-C3N4) and cerium oxide nanoparticles

Mahshad Shafiee Sarvestani, **Ali Benvidi***, **Mansoure Alighiyan Baghkhandan**
[a]*Department of Chemistry, Faculty of Chemistry, Yazd University, Yazd, Iran*

abenvidi@yazd.ac.ir; benvidi89@gmail.com

Abstract

Tryptophan is one of the essential amino acids which its detection is important due to its vital role in physiological processes such as the synthesis of neurotransmitters and protein formation.

The use of tryptophan supplements in the treatment of depression and sleep disorders has gained attention due to its relationship with the production of serotonin (5-HT) and melatonin. Tryptophan is also utilized to assist in addressing cognitive issues, anxiety, and neurodegenerative diseases.

Reduced levels of serotonin are linked to conditions such as autism spectrum disorder, obesity, anorexia, and bulimia nervosa, as well as other diseases that exhibit peripheral symptoms. Scientific literature strongly emphasizes that tryptophan plays a crucial role in the optimal functioning of the brain-gut axis and the immune system. [1-4].

In this article, a screen-printed electrode modified with graphite carbon nitride (g-C3N4) as electrocatalytic modifier and cerium oxide nanoparticles (CeO_2 NPs) which has increased the surface area, has been used, for determination of tryptophan.

The effective parameters such as pH graphite carbon nitride and CeO_2 NPs percents, were optimized using response surface methodology (RSM). In the optimized conditions, the linear range and detection limit were obtained for tryptophan using differential pulse voltammetry to be 0.1 µM to 120 µM and 0.085 µM. The applicability of the proposed method was investigated in real samples such as blood serum.

Keywords: Tryptophan, Screen printed electrode, Graphite carbon nitride, Response surface methodology optimization, Electrochemical methods.

References:

[1] H. A. Abebe, A. Diro and S. A. Kitte, *Heliyon* 9 (2023) 21033 .
[2] S. Garg, A. Singh, A.S. Parmar and Rosy *ACS Applied Nano Materials*, 6 (2023) 14849.
[3] Ž. Z. Tasić, M. B. P. Mihajlović, M. B. Radovanović, A. T.Simonović, D. V. Medić and M. M. Antonijević, *Scientific Reports*,12 (2022) 5469.
[4] S. Yao, S. Xue, S. Peng, M. Jing, X. Qian, X. Shen, T. Li and Y. Wang, *Journal of Materials Science: Materials in Electronics*, 29 (2018) 17921.

Modification of carbon paste electrode to enhance electrochemical determination of 2,4,6-Trichlorophenol

Niloofar Nosratabadi*[a], **Hadi Beitollahi**[b], **Fariba Garkani Nejad**[b]

[a] *Department of Chemistry, Faculty of Chemistry and Chemical Engineering, Graduate University of Advanced Technology, Kerman, Iran*

[b] *Environment Department, Institute of Science and High Technology and Environmental Sciences, Graduate University of Advanced Technology, Kerman, Iran*

**E-mail: niloofar.nosrati1376@gmail.com*

Abstract

2,4,6-Trichlorophenol (2,4,6-TCP) is one of the compounds that is extensively used in the production of fungicides, herbicides, and insecticides. Also, this compound is used as an intermediate material in various production processes, including the production of dyes, pigments, and medicines [1]. However, it can lead to the pollution of water bodies and is very harmful to human health. Therefore, in order to protect the environment and ensure human health, it is crucial to develop simple, fast, and sensitive analytical methods for the quantification of 2,4,6-TCP in environmental samples. Electrochemical techniques demonstrated good performances for the analysis of various compounds in environmental samples and biological fluids due to their advantages including cost-effective instruments, short analysis time, simplicity of operation, and high sensitivity [2]. In this work, two-dimensional metal-organic framework (2D Ni-MOF nanosheets) and graphene oxide (GO) modified carbon paste electrode (CPE) was applied to prepare an electrochemical sensing platform for determination of 2,4,6-TCP. The cyclic voltammetry (CV) studies revealed that the Ni-MOF nanosheets and GO modified CPE has a synergetic effect on the oxidation of 2,4,6-TCP. The designed sensor showed a linear response to 2,4,6-TCP in the 0.01 to 800.0 μM concentration range by using differential pulse voltammetry (DPV) with a low detection limit of 0.004 μM. Moreover, determination of 2,4,6-TCP in the water samples was investigated and good recoveries were obtained. Based on the good performance of the modified CPE, the prepared sensor possesses outstanding advantaged for determination of 2,4,6-TCP in the water samples.

Keywords: 2,4,6-Trichlorophenol, Carbon paste electrode, Electrochemical sensing platform, Environmental pollution.

References

[1] B. Arumugam, S. Palanisamy, G. Janagaraj, S.K. Ramaraj, M. Chiesa and C. Subramanian, *Surfaces and Interfaces*, 39 (2023) 102930.

[2] X. Zheng, S. Liu, X. Hua, F. Xia, D. Tian and C. Zhou, *Electrochimica Acta*, 167 (2015) 372-378.

Copper Tungstate Composite with MXene as Bifunctional Electro-catalysts for Water Splitting Reactions

Parisa Rezvaninia[a], **Ahmad Amiri**[a]*

[a]*Department of Chemistry, College of Science, University of Tehran, Tehran 14155-6455, Iran.*

**E-mail: Parisarezvaninia@gmail.com*

Abstract

The rising use of fossil fuels has led to significant interest in clean and sustainable energy alternatives [1]. Thus, splitting water into hydrogen and oxygen is one of the most attractive scenarios for solar energy harvesting and sustainable energy production [2]. So far, noble metals like Ru, Ir, and Pt, along with their oxides, have been the most effective electro-active materials for hydrogen evolution reaction (HER) and oxygen evolution reaction (OER). However, their high cost and limited availability hinder their widespread commercial use [3]. MXenes are a family of 2D transition metal carbides, nitrides, and carbonitrides with surface termination groups such as -OH, -O, and -F. The presence of transition metal imparts conductivity, surface termination groups induce hydrophilicity and layered structure offers a large surface area, making MXenes a potential candidate to be utilized as an electro-catalyst with enhanced efficiency [4]. Within this context, the copper tungstate composite with MXene was prepared and characterized with SEM, and its electrocatalytic activity was investigated. In conclusion, we present this material as a significant electrocatalyst for HER, OER, and bifunctional applications. The $CuWO_4$ showed Tafel slopes of 1513 and 2044 mV dec^{-1} for the OER and HER in 0.5 M KOH and 0.5 M H_2SO_4, respectively, while the $CuWO_4@Ti_3C_2$ nanocomposites demonstrated lower Tafel slopes of 749 and 582 mV dec^{-1} for the OER and HER in 0.5 M KOH and 0.5 M H_2SO_4.

Keywords: MXenes, Electrochemical Water Splitting, Hydrogen Evolution Reactions(HER), Oxygen Evolution Reactions(OER)

References

[1] Z. Q. Wang, L. Z. Tang, Y. X. Zhang, S. Z. Zhan, and J. S. Ye, “Electrochemical-driven water splitting catalyzed by a water-soluble cobalt (II) complex supported by N, N′-bis(2′-pyridinecarboxamide)-1,2-benzene with high turnover frequency,” *J Power Sources*, vol. 287, pp. 50–57, Aug. 2015.

[2] S. Bai *et al.*, “Recent advances of MXenes as electrocatalysts for hydrogen evolution reaction,” Dec. 01, 2021, *Nature Research*.

[3] J. Ahmed *et al.*, “Molten Salts Derived Copper Tungstate Nanoparticles as Bifunctional Electro-Catalysts for Electrolysis of Water and Supercapacitor Applications,” *ChemElectroChem*, vol. 5, no. 24, pp. 3938–3945, Dec. 2018.

[4] M. P. Browne, D. Tyndall, and V. Nicolosi, “The potential of MXene materials as a component in the catalyst layer for the Oxygen Evolution Reaction,” *Curr Opin Electrochem*, vol. 34, p. 101021, Aug. 2022.

Development of electrochemical sensor for Methylphenidate detection

Maliheh Arhami[a], Faezeh Shahdoost Fard[b]*, Alireza Asghari[c], Maryam Rajabi[d]

[b]*Department of chemistry, Faculty of chemistry, Farhangiyan University, Tehran, Iran*

[c,d]*Department of chemistry, Faculty of chemistry, Semnan University, Semnan, Iran*

**E-mail: [a]negarhami.4038@gmail.com*
[b]shahdost@cfu.ac.ir*

Abstract

Methylphenidate (MPH) is one of the most commonly prescribed stimulants for attention deficit hyperactivity disorder and its abuse is recently increasing with its growing availability. So, it's detecting and monitoring in human biofluids is paramount importance because of the severe side effects.

This study introduces an electrochemical MPH sensor based on the polypyrrole/β-cyclodextrin (Ppy/β-CD) film. The Ppy/β-CD film was prepared by a simple electropolymerization method on the glassy carbon electrode (GCE) in a 20:1 mixture of the CD and the pyrrole monomer LiClO4 as the supporting electrolyte. The sensing behavior of MPH on the Ppy/β-CD/GCE surface was investigated by cyclic voltammetry (CV) and differential pulse voltammetry (DPV) techniques and showed good results in detecting different concentrations of MPH than the polymer layer individually.

Ppy/β-CD/GCE indicates electrochemical response towards MPH from 2 μM to 10 μM. The Ppy/β-CD/GCE is promising to detect MPH in human real samples.

Keywords: Methylphenidate, electrochemical sensor, polypyrrole.

References

[1] D. Pan, X.-X. Xia, H. Zhou, S.-Q. Jin, Y.-Y. Lu, H. Liu, M.-L.Gao, Z.-B. Jin, COCO enhances the efficiency of photoreceptor precursor differentiation in early human embryonic stem cell-derived retinal organoids, Stem Cell Res. Ther. 11 (2020)1–12.

[2] J. Huang, G.S. Kumar, Y. Sun, Evaluation of workability and mechanical properties of asphalt binder and mixture modified with waste toner, Constr. Build. Mater. 276 (2021), 122230.

Extraction of lead ion from waste water using functionalized and magnetic active carbon and its determination suing differential pulse voltammetry

Fatemesadat Norouzzadeh, **Ali Benvidi***

Department of Chemistry, Yazd University, Yazd, Iran

*E-mail: *abenvidi@yazd.ac.ir; benvidi89@gmail.com*

Abstract

Heavy metal pollution such as mercury, lead, etc. has become an important environmental issue with the development of industry. Their high carcinogenic property and biological accumulation make scientists to search for a simple and effective way to remove heavy metal ions from wastewater [1]. Activated carbon is a well-known material used in a large number of environmental applications. High surface area, a microporous structure, and a high degree of surface reactivity make activated carbon materials versatile adsorbents, particularly effective in the adsorption of organic and inorganic pollutants from aqueous media. Carbon structures contain the main functional groups that are responsible for pollutant adsorption. Adsorption properties are unique to functional groups [۲-4]. In this experiment, carbon was produced from pistachio skin and waste and activated by zinc chloride through a chemical method under pyrolysis conditions (580ºC) and then was washed with sulfuric acid 0.01 M at a specific temperature and time, which was used to adsorb heavy metals such as mercury and lead. The effective parameters in extraction such as pH, adsorbent amount, contact time, and temperature were optimized. The concentration of lead ion in the solution after removal was determined by differential pulse voltammetry (DPV) using platinum as working electrode and concentration of mercury ion in solution by DPV using screen printed electrode. The experiments show that removing of lead ion from initial concentration of 100 ppm was done 99.0% of lead ion by 0.08 g adsorbent which is a satisfactory result.

Keywords: Activated carbon , Adsorption , Agricultural waste , Chemical activation , differential pulse voltammetry

References

[1] G. Zhao, J. Li, X. Ren, C. Chen and X. Wang, *Environmental Science*, 45 (2011) 10454.
[2] R. I. Kosheleva, A. C. Mitropoulos and G. Z. Kyzas, *Environmental Chemistry Letters*,17 (2019) 429.
[3] A. Bhatnagar, W. Hogland, M. Marques and M. Sillanpää, *Chemical Engineering Journal*, 219 (2013) 499.
[4] G. Crini, E. Lichtfouse, L. D. Wilson and N. Morin- Crini, *Environmental Chemistry Letters*, 17 (2019) 195.

A Novel Composite of Mn, Co-LDH and Reduced Graphene Oxide for Application in Energy Storage Device

Tahere Khatti[a], Mohammad Mazloum-Ardakani[a]*, Zahra Alizadeh[a], Zahra Souri[a]
[a]Department of Chemistry, Faculty of Sciences, Yazd University, Yazd, Iran

**E-mail: Mazloum@yazd.ac.ir*

Abstract

Background:
The increasing demand for energy storage devices with high performance motivates the development of supercapacitors (SCs) as a great energy storage system. Among various materials employed in supercapacitors electrodes, layered double hydroxides (LDH) have attracted obvious attention owing to their large surface area, tunable chemical composition and high conductivity. The reduced graphene oxide (RGO) is also served as a great material for energy storage through the EDLC mechanism. Furthermore, poly-dibenzoazepine (PDB) which recently reported to have an amazing porous structure could provide the large surface area needed in SCs. Accordingly, in the present study, a nanocomposite based on RGD-PDB-LDH gown on stainless steel mesh (SS) via green and eco-friendly electrochemical deposition techniques was fabricated to achieve a promising candidate for SC application.
Results:
All steps of the procedure were accomplished via electrochemical deposition techniques using no binder or chemical modification of the substrate. The electrode was assessed by cyclic voltammetry, galvanostatic charge discharge, and impedance spectroscopy methods. The obtained surveys indicated that the nanostructure electrode has a specific capacitance of 261.0 F g^{-1}at 1.0 A g^{-1}. The hybrid RGO-PD-LDH@SS was contrasted with four other electrodes obtained by each component of the electrode, including LDH@SS, RGO@SS, PD@SS, LDH-PD@SS electrodes. It was observed that the specific capacity was dramatically enhanced in the hybrid structure.

Significance:

- A hybrid nanostructure RGO-PD-LDH@SS electrode was constructed via electrochemical deposition methods with a specific capacitance of 261.0 F g^{-1}at 1.0 A g^{-1}which would be suited for application in energy storage devices.

Keywords: Supercapacitor1, Layered double hydroxide 2, Reduced graphene oxide3, poly-dibenzoazepine4

References

[1] Avraham, Hanan, et al. *Journal of The Electrochemical Society* 168.9 (2021): 090506.

[2] Wang, Q., & O’Hare, D., *Chemical reviews* ,*112*(2012), 4124-4155.

[3] Souri, Z., Mazloum-Ardakani, M., Alizadeh, S., & Nematollahi, D., *Journal of Energy Storage*, *55* (2022)105381.

Design and fabrication of an electroforming machine to produce security holograms and improve their quality using nickel sulfamate solution

Javad Ghadimi[a,b]*, Sara Asgari[b], Akbar Rezaei SarvOlya[a] , AliReza Zolfagharian[a], Babak Ebadi[a], Mahdi Piroozmand[a]
[a]*Department of BioElectronic, PNR Co., Tehran, Iran*

[b]*Department of Research and Technology, Imam Khomeini Oil Refining Co., Arak, Iran*

**E-mail: j.ghadim68@gmail.com*

Abstract

Electroforming is defined as the fabrication of free-standing components using electrodeposition. Nickel electroforming has unique advantages, making it the only method to manufacture familiar products such as security holograms. The process route for hologram production involves the surface of the origination being coated with a very thin layer of metal to make it electrically conductive. Nickel metal is then electrodeposited onto this layer to produce a mechanically robust copy, perfect in detail, of the original image.

In this work, we designed and fabricated an electroforming machine to produce security holograms and improve their quality using the nickel-sulfamate solution. The as-built tub electroplating machine is made of a double-layer polypropylene which reduces corrosion against solutions and is non-conductive against electricity, and equipped with other equipment such as filters, pumps, voltage and current power supply, immersion heater with thermostat, anode basket, dummy cathodes, etc. Working with this machine is more convenient since it controls the process temperature, time, voltage, current, and circulation rate and determines the hardness and pH of the solution at any time [1]. The important parameters such as electrode distance are optimized for the best results.

The sulfate solution was also replaced with sulfamate solution due to its advantages like chemical constituents, additive-free system, and lower operational current and deposition time [2]. The 60% w/v nickel sulfamate solution was synthesized using sulfamic acid and nickel carbonate. The process was optimized to achieve a clear green-colored liquid with min. 11% w/v Ni content [3].

This system was specially designed for electroforming holograms using nickel sulfamate solution without any additives. At the end of the cycle, the holograms are flexible and removed from the shims easily and immediately.

Keywords: Electroforming, Security hologram, Nickel sulfamate, Electroplating tub

References

[1] Z. Rao, S.J. Hearne, E. Chason, *Journal of The Electrochemical Society*, 166 (2018) D3212-D3218.
[2] S. Roy, E. Andreou, *Current Opinion in Electrochemistry*, 20 (2020) 108-115.
[3] D. Baudrand, *Metal Finishing*, 94 (1996) 15-18.

Construction & Design of Modified Carbon Paste Electrochemical Sensor Based on CeO_2-ZnO Nanocomposite for the Determination of Gallic Acid

Mohammad Shahsavani[a], **Javad Tashkhourian**[a]*

[a]*Department of chemistry, Faculty of science, Shiraz university, Shiraz, Iran*

**E-mail: tashkhourian@shirazu.ac.ir*

Abstract

Analyzing of the food components, particularly antioxidants within intricate matrices, has emerged as a significant challenge. There is a pressing need for the advancement of monitoring methods that are sensitive, selective, and reliable. Our idea for constructing an electrochemical sensor for the assay method was to combine two kinds of metal-oxide nanoparticles (CeO_2-ZnO) modified carbon paste electrode was developed for the voltammetric determination of gallic acid (GA). Studying the electrochemical characteristics of modified electrode revealed the modified electrode can exhibit excellent catalytic activity, wide dynamic linear range, low detection limit, good sensitivity, and high accuracy. Under optimized conditions, using the developed electrochemical sensor, two linear response ranges of 0.01–10.0 µM and 10.0 –100.0 µM with a limit of detection of 5.3 nM was achieved for GA. Finally, the CeO_2-ZnO/CPE sensor was successfully applied toward the determination of GA in the different tea samples.

***Keywords**:* Electrochemical sensor; Gallic acid; Cerium oxide; Zinc oxide; Square wave voltammetry

References

[1] Mahmoudi, Z., Tashkhourian, J. and Hemmateenejad, B., **2022**. A disposable paper-based microfluidic electrochemical cell equipped with graphite-supported gold nanoparticles modified electrode for gallic acid determination. *Journal of Electroanalytical Chemistry*, *920*, 116626.

[2] Li, J., Yang, Y., Li, Y., Zhao, P., Fei, J. and Xie, Y., **2023**. Detection of gallic acid in food using an ultra-sensitive electrochemical sensor based on glass carbon electrode modified by bimetal doped carbon nanopolyhedras. *Food Chemistry*, 429, 136900.

Construction and application of an electrochemical sensor utilizing hybrid metal sulfides functionalized with graphene oxide for detection of sunset yellow

Hanieh Ghaedi[a], Khadijeh ghanbari[*a]

[a] Department of Analytical Chemistry, Faculty of Chemistry, Alzahra University, Tehran, Iran

[*] *E-mail:* kh.ghanbari@alzahra.ac.ir

Abstract

Sunset yellow, which is a well-known type of azo dyes, is commonly found in many snacks; however, its overuse poses significant dangers to human health. As a result, the use of synthetic food dyes in food products is strictly regulated by various national laws to ensure safety. These stringent regulations strongly encourage scientists to find quick and simple methods to effectively monitor food products. In this research, a new and innovative electrochemical sensor was developed by modifying a carbon paste electrode with metal sulfide (ZnS/SnS2) and modified graphene oxide (SRGO). The modified ZnS/SnS2-SRGO electrode exhibited remarkable electrocatalytic activity for the oxidation of sunset yellow compared to the carbon paste electrode. The morphology and structure of the nanocomposite was investigated using different advanced techniques such as X-ray photoelectron spectroscopy (XPS) and Field Emission Scanning Electron Microscope (FE-SEM). Differential pulse voltammetry, cyclic voltammetry, and impedance techniques were employed to accurately measure samples and study surface conduction. The results indicated a significant increase in surface conductivity. The detection limit was found to be 0.13 μM, and the linear response range was determined to be 3-100 μM.

Keywords: Electrochemical sensor, sunset yellow, nanocomposite, metal sulfide, Graphen oxide.

References

[1] P. Negi *et al.*, “Isolation of Food Grade Dye from Flower Petals of Butea monosperma and Determination of Marker Compounds for Its Quantitative Analysis.,” *ACS omega*, vol. 8, no. 20, pp. 17740–17747, May 2023, doi: 10.1021/acsomega.3c00485.

[2] W. Yao *et al.*, “ZnS-SnS@NC Heterostructure as Robust Lithiophilicity and Sulfiphilicity Mediator toward High-Rate and Long-Life Lithium–Sulfur Batteries,” *ACS Nano*, vol. 15, no. 4, pp. 7114–7130, Apr. 2021, doi: 10.1021/acsnano.1c00270.

Cyclic Voltammetry Study of the Interactions of Schiff base complex with DNA and HAS

Melika Nikseresht[a], Ahmad Amiri[a]*
(Times New Roman; size 12, centered and bold)

[a]*Department of chemistry Faculty of science, University of Tehran, Tehran, Iran*

E-mail: mnikseresht74@gmail.com

Abstract: At present, cancer is the leading cause of death worldwide. Since the intracellular target for a wide range of anticancer and antibiotic drugs is deoxyribonucleic acid (DNA), the studies of interaction of drug molecules with DNA have become an active area of research in recent years. It is also important to study the interaction of drugs with serum albumin that gives an additional advantage to use them as a potential drug as it is well known that the plasma protein human serum albumin (HSA) acts as an effective carrier of many drugs. These studies can greatly help to understand drug–DNA interactions and design of new and promising drugs for clinical use [1].

The application of electrochemical measurements of the redox couples of metal-based antitumor potential drugs in the presence of DNA is a highly sensitive method due to the resemblance between the electrochemical and biological reactions. CV provides a useful complement to the other biophysical methods of investigations such as UV-visible spectroscopy and fluorescence studies [2].

In this study, a Schiff-base complexe has been synthesised by the reaction of Manganese(II) acetate with the 2-(hydroxymethyl)-2-(((3-hydroxynaphtalen-2-yl)methylene)amino)propane-1,3-diol and characterised by UV–Vis and FT-IR. then its interactions with calf thymus-DNA (CT-DNA) and HSA has been studied using cyclic voltammetry (CV) at a DNA or HSA-modified gold electrode. The variations in the cyclic voltammetric behavior of different concentrations of drugs with CT-DNA and HSA have been investigated. The result showed that the drug has the good ability to bind and interaction with DNA and HSA.

Keywords: cyclic voltammetry, DNA, Schiff-base

References

[1] Perveen, Fouzia, Rumana Qureshi, Farzana Latif Ansari, Saima Kalsoom, and Safeer Ahmed. "Investigations of drug–DNA interactions using molecular docking, cyclic voltammetry and UV–Vis spectroscopy." *Journal of Molecular Structure* 1004, no. 1-3 (2011): 67-73.

[2] Sirajuddin, Muhammad, Saqib Ali, and Amin Badshah. "Drug–DNA interactions and their study by UV–Visible, fluorescence spectroscopies and cyclic voltametry." *Journal of Photochemistry and Photobiology B: Biology* 124 (2013): 1-19.

Electrocatalytic H2 evolution of Cobalt (III) Schiff base complex as catalyst on homogenous phase

Kowsar Zabihpour[a], **Ahmad Amiri**[a]*
[a]Department of chemistry Faculty of science, University of Tehran, Tehran, Country

E-mail: K.zabihpour1374@gmail.com

Abstract: One of humanity's greatest challenges in today's society is the replacement of clean energy with fossil fuels. Water splitting through electrocatalysts is one of the production methods for hydrogen in renewable energy systems. Hydrogen is considered a significant resource in renewable energy systems. Hydrogen can be produced using this clean, renewable energy. A Schiff base catalyst is considered to be one of the most famous electrocatalysts for water splitting due to its high catalytic activity.[1]

In this study, we report the electrocatalytic behavior of the Co(III) complex of [CoL_2], for hydrogen evolution in buffer phosphate and dimethylformamide. The homogeneous catalytic hydrogen evolution reaction (HER) of three-coordinate Schiff base ligand with the metal Co(III) has been studied in aqueous solution and then in non-aqueous solution. However, the high overpotential, time-consuming synthesis process, and complicated working conditions limit their application. A water-soluble octahedral cobalt (III) complex, [$Co(L)_2$], (L = 4-Bromo-2-[(2-hydroxy-phenylimino) methyl]-phenol), was synthesized and characterized by UV-Vis, FT-IR, and Single-Crystal X-ray diffraction techniques.[2]

First, the tridentate Schiff base precursor H2L is incorporated into [$Co (L)_2$]. This compound is used as an electrocatalyst for hydrogen evolution through proton or H2O reduction in homogeneous systems. In an electrocatalytic H2 evolution study involving CV and CPE, it was demonstrated that the compound has a high efficiency of proton reduction in homogeneous systems using acetic acid as a proton source in non-aqueous and aqueous solvents.[3]

The electrocatalytic water splitting activity of [CoL_2] showed that complex is highly active for [CoL_2] the water splitting in aqueous solutions. A Turn Over Frequency (TOF) value of 160.41 mol of hydrogen per mole of catalyst per hour was measured at an overpotential of 1700 mV (pH = 6). These results can be attributed to the flat ligands, the electroactivity of the metal center and the Schiff base ligand, and the loss of axial ligands around the metal-ion center during the reduction process, which offers different reduction pathways during an HER process. In addition, the Spectro electrochemical technique confirms the proposed mechanism.[4]

Keywords: cyclic voltammetry, HER, Schiff-base

References

1. Fang, T., et al., *Electrochemical-driven water reduction catalyzed by a water soluble cobalt (III) complex with Schiff base ligand.* Electrochimica Acta, 2015. 178: p. 368-373.
2. Schlapbach, L., Hydrogen-fuelled vehicles. Nature, 2009. 460(7257): p. 809-811.
3. Haddad, A.Z., et al., Metal-assisted ligand-centered electrocatalytic hydrogen evolution upon reduction of a bis (thiosemicarbazonato) Cu (II) complex. Inorganic chemistry, 2017. 56(18): p. 11254-11265.
4. Hong, X.S., et al., Electrocatalytic and photocatalytic hydrogen evolution by Ni (II) and Cu (II) schiff base complexes. ChemElectroChem, 2020. 7(24): p. 4956-4962.

Investigating the Binding Modes of a Schiff-Base Ligand to DNA: Insights from Electrochemical and Spectroscopic Techniques for Anticancer Applications

Sudabeh Shokrollahi[a], Ahmad Amiri[a*]

[a]*Department of chemistry Faculty of science, University of Tehran, Tehran, Iran*

[*]*E-mail: sudabe.sh6969@gmail.com*

Abstract:

DNA has long been recognized as a crucial target for various cytotoxic anticancer agents, making its interaction with drug molecules a vibrant research field that bridges chemistry, molecular biology, and medicine. Understanding these interactions is essential for elucidating drug action mechanisms and developing more effective medications with reduced side effects [1,2]. In this study, we investigate the binding modes of a synthesized Schiff-base ligand, N,N′-Bis(2-hydroxy-3-methoxy-benzylidene)-naphthalene-1,5-diamine (NSL), to the DNA macromolecule for potential cancer treatment. The Schiff-base was synthesized through the reaction of 1,5-naphthalenediamine (p-ND) with 2-hydroxy-3-methoxybenzaldehyde and characterized using various spectroscopic techniques, including ultraviolet-visible (UV-Vis), infrared (IR), and proton nuclear magnetic resonance (^{1}H-NMR). We assessed its anticancer activity by studying the interaction of NSL with calf thymus DNA (ct-DNA) using isothermal titration calorimetry in a tris buffer with 10 mM sodium chloride, obtaining key thermodynamic parameters. Additionally, we compared data from cyclic voltammetry (CV) and fluorescence spectroscopy to further elucidate the binding modes. The CV results demonstrate that NSL tightly binds to ct-DNA and intercalates between the DNA base pairs, with its side chains extending along the minor groove and covering eight base pairs. This study provides valuable insights into the affinity parameters of the interaction between DNA and this targeting compound, presenting a sensitive approach in the realm of electrochemistry for cancer treatment research.

Keywords: cyclic voltammetry, DNA, Schiff-base, fluorescence spectroscopy

References

[1] Arshad, Nasima, and Shahid Iqbal Farooqi. "Cyclic voltammetric DNA binding investigations on some anticancer potential metal complexes: a review." *Applied biochemistry and biotechnology* 186, no. 4 (2018): 1090-1110.

[2] Shokrollahi, Sudabeh, Ahmad Amiri, Farzaneh Fadaei-Tirani, and Kurt Schenk-Joß. "Promising anti-cancer potency of 4, 5, 6, 7-tetrahydrobenzo [d] thiazole-based Schiff-bases." *Journal of Molecular Liquids* 300 (2020): 112262.

Cobalt (III) Based Catalyst for Water Splitting Reactions

Seyed Farzad Hosseini[a], Parisa Rezvaninia[a], Ahmad Amiri[a]*

[a]Department of Chemistry, College of Science, University of Tehran, Tehran 14155-6455, Iran.

[*]E-mail: farzadhosseini11@yahoo.com

Abstract

The electrochemical splitting of water is an attractive method for energy storage and conversion, helping to reduce dependence on dwindling fossil fuel supplies and mitigate significant damage to the global climate[1]. Water splitting stands out as an efficient method for generating high-purity hydrogen and oxygen[2]. Particularly, significant advancements have been achieved in the growth of molecular catalysts for hydrogen and oxygen production, employing earth-abundant transition metals[3], [4]. Cobalt complexes with polypyridyl ligands, recognized for their stability and electroactivity at both the metal and ligand sites, have attracted significant interest. In this context, a Co (III) complex with the formula $[CoL(NCS)(OH_2)]$, has been synthesized and thoroughly characterized using CHN elemental analysis, IR, UV-Vis, and X-ray powder diffraction techniques. The crystal structure analysis of the complexes reveals that the anionic ligand L, forming an N4 set, is situated in the equatorial plane. Simultaneously, the two H_2O and NCS ligands occupy the axial positions, resulting in a distorted octahedral geometry around the Co (III) center. The electrocatalytic performance of this complex in water-splitting reactions has been explored, indicating creditable electrocatalytic activity in hydrogen and oxygen evolution reactions with a respectable turnover frequency at pH=7. Our approach to creating efficient and stable molecular catalysts using readily available transition metal ions offers a simple method for designing and producing molecular electrocatalysts for OER and HER.

Keywords: Electrochemical Water Splitting, Hydrogen Evolution Reaction (HER), Oxygen Evolution Reactions (OER)

References

[1] A. Raveendran, M. Chandran, and R. Dhanusuraman, “A comprehensive review on the electrochemical parameters and recent material development of electrochemical water splitting electrocatalysts,” *RSC Adv*, vol. 13, no. 6, pp. 3843–3876, Jan. 2023, doi: 10.1039/D2RA07642J.

[2] Z. Q. Wang, L. Z. Tang, Y. X. Zhang, S. Z. Zhan, and J. S. Ye, “Electrochemical-driven water splitting catalyzed by a water-soluble cobalt(II) complex supported by N,N′-bis(2′-pyridinecarboxamide)-1,2-benzene with high turnover frequency,” *J Power Sources*, vol. 287, pp. 50–57, Aug. 2015, doi: 10.1016/J.JPOWSOUR.2015.04.031.

[3] A. Khademi, A. Amiri, F. Fadaei Tirani, and K. Schenk-Joß, “Co(III) carboxamide complexes as electrocatalysts for water splitting,” *Int J Hydrogen Energy*, vol. 47, no. 38, pp. 16921–16932, May 2022, doi: 10.1016/J.IJHYDENE.2022.03.195.

[4] W. Zhang, L. Cui, and J. Liu, “Recent advances in cobalt-based electrocatalysts for hydrogen and oxygen evolution reactions,” *J Alloys Compd*, vol. 821, p. 153542, Apr. 2020, doi: 10.1016/J.JALLCOM.2019.153542.