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Dear Colleagues,

Persian Gulf University is delighted to organize the 13th Biennial Electrochemistry seminar of Iranian chemical society. This seminar is a forum for presentation and discussion of the most recent advancements in all fields of electrochemistry, including molecular electrochemistry, biosensors, bio-electrochemistry, batteries and energy, corission, electrochemical impedance spectroscopy, biofuel cells, and supercapacitors.

Plenary and invited speakers, oral presentations and poster sessions as well as two workshops are arranged in the program of present biennial seminar. We expect that these specific topics could fulfill our main goals and trends of development in electrochemistry research.

I gratefully acknowledge the members of scientific committee for peer reviewing of abstracts and the organizing committee members, and the vice-chancellor for research of Persian Gulf University for their supports.

It is a great pleasure and an honor to welcome you; honorable guests, lecturers, researchers and participants, to this fantastic event.

On behalf of scientific and executing committees

Hossein Eslami

Sadegh Karimi

Mohammd Reza Mohamadizadeh

Esmail Tammari

Sedigheh Hashemnia

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Dr. Ayemeh Bagheri Hashkavayi

Wednesday, 27 February

Opening ceremony	**8:30-9:30**	Opening lectures
Invited Speaker 1	**9:30-10:00**	**Dr. Mehran Javanbakht** Materials challenges and opprtunities of lithium ion batteries
Poster section and break	**10:00-11:00**	
Invited Speaker 2	**11:00-11:30**	**Dr. Mirghasem Hosseini** Electrochemistry of mixed metal oxide and their industrial applications
Invited Speaker 3	**11:30-12:00**	**Dr. Masoud Ayatollahi Mehrgardi** Cancer diagnosis using aptamer-based electrochemicalbiosensors
Oral presentations	**14:00-14:25**	**Dr. Davood Nematollahi** Electrochemical research fields in Iran
	14:25-14:50	**Dr. Sedigheh Hashemnia** Electrochemical biosensors based on functionalized magnetic nanoparticles
	14:50-15:15	**Dr. Saied Saeed Hosseiny Davarani** High-performance supercapacitors and their applications
Poster section and break	**15:15-16:00**	
Workshop	**15:30-17:00**	**Dr. Mirghasem Hosseini** Corission and Electrochemical impedance spectroscopy (*Theoretical part)*

Oral presentations	**16:00-16:25**	**Saber Alizadeh** Electrosynthesis of the Metal-Organic Framework thin films
	16:25-16:50	**Dr. Hedayatollah Ghourchian** Recent advances in Bio-Analysis lab for development of electrochemical biosensors and biofuel cells
	16:50-17:15	**Dr. Ayemeh Bagheri Hashkavayi** Ultrasensitive electrochemical aptasensors for biomedical applications
Workshop	**17:00-18:00**	**Dr. Mirghasem Hosseini** Corission and Electrochemical impedance spectroscopy *(Experimental part)*

Thursday, 28 February

Oral presentations	**8:30-8:55**	**Dr. Jahanbakhsh Raoof** Electrochemical biosensors based on nucleic acidsfor the study of DNA damage
	8:55-9:20	**Dr. Mohsen Saremi** Application of Scanning Vibrating Electrode Technique (SVET) on elucidating the mechanism of stress corrosion cracking of 304L stainless steel
	9:20-9:45	**Dr. Abbas Afkhami** Impedimetric sensors and biosensors for direct determination of some biologically important compounds
Poster section and break	**9:45-10:30**	
Oral presentations	**10:30-10:55**	**Dr. Saeed Bahadori Khalili** High performance Lithium-Ion Batteries: Application of plasma polymerization on cycle life and capacity of the cells
	10:55-11:20	**Dr. Ghasem Azarian** Electrocoagulation process for recycling of industrial wastewater: laboratory and semi-industrial studies
Workshop	**11:20-12:00**	**Dr. Darioush Rezaee** Chemical industries and Entrepreneurship

Materials Challenges and Opportunities of Lithium Ion Batteries

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A renewable energy such as solar, wind and geothermal can be stored in lithium-ion batteries (LIBs). LIBs include good electrochemical properties such as high energy density, high voltage and high capacity. Also, LIBs have been extensively used for electric vehicle (EV), Hybrid electric vehicles (HEV) and portable electronic devices. As a technological component, LIBs present huge global potential towards energy sustainability and substantial reductions in carbon emissions.The success of lithium ion technology for the latter applications will depend largely on the cost, safety, cycle life, energy, and power, which are in sequence controlled by the component materials used. The critical challenge of LIBs is electrochemical performance of the needed advanced materials. Accordingly, this outlook focuses on the challenges and views associated with the electrode materials. The issue associated with future batteries market and specifically electrode materials and the approaches to overcome the challenges are presented. Some rational ideas and strategies regarding the development of new electrode materials to dramatically reduce the cost and increase the efficiency of future lithium ion batteries are presented.

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Electrochemistry of Mixed Metal Oxides and their Industrial Applications

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Mixed metal oxide based electrocatalytic anodes are a different type of anodes when compared to conventional anodes. MMO originally developed to produce chlorine from seawater electrolysis. MMO anodes have been used in cathodic protection (CP) applications since the 1980s. These anodes are dimensionally stable, long life anodes that are not consumed during the process of generating cathodic protection current. MMO anodes have imperceptibly low wear rates and are often referred to as Dimensionally Stable Anodes as they do not change geometry over time. These electrodes are widely used in different industries such as chlor-alkali and cathodic protection, recovery of metals in electrowining process and purification of waste water. Usually, titanium electrodes are coated with metal oxides such as RuO_2, IrO_2, SnO_2, TiO_2,*etc*. are known as Mixed Metal Oxides. In this presentation, I look over of our experiences work in last decade on the electrochemistry of MMO and their industrial applications.

Cancerdiagnosis using Aptamer-Based Electrochemical Biosensors

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Cancer is one of the main causes of death and its early diagnosis increase the chance for survival of patients significantly [1**]**. Aptamers are single-stranded DNA or RNA that are identified from random sequence libraries by systematic evolution of ligands by exponential enrichment (SELEX) and they are specifically bonded to their targets. Aptamers are known as promising alternatives for antibodies in protein recognition and sensing as well, due to their simple synthesis, easy storage, excellent controllability and wide applicability. Furthermore, they form well-ordered structures, with high affinity and specificity, which are bonded to various targets, such as inorganic ions, small molecules, proteins and even whole-cells [2]. In this seminar, the recent advances and findings of our research team in the both fields of earlydiagnosis of cancers will be presented. To develop the novel strategies for the earlydiagnosis of cancers as the most vital key in the efficient treatment of cancers, the application of newnanostructures including, carbon dots, graphene nanosheets, metallic nanoclusters for the designing of aptamer-based electrochemical Biosensors has been reviewed [3-5].

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Electrochemical research field in Iran

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الکتروشیمی علمی است که در زمینه های بسیار متنوع و گوناگونی قادر است به بشریت کمک کند. یک بررسی اجمال نشان می دهد که این علم در زمینه هایی همچون:

- Analytical electrochemistry
- Bio electrochemistry
- Electrochemical energy conversion and storage
- Electrochemical materials science
- Electrochemical process engineering and technology
- Environmental electrochemistry
- Molecular electrochemistry
- Physical electrochemistry

نقش بسیار پر رنگی می تواند در ورود دانشگاهها به دانشگاههای نسل سوم ایفا کند. دانشگاههای نسل سوم یا دانشگاههای کار آفرین دانشگاههایی هستند که علاوه وظایف قبلی خود یعنی آموزش و پژوهش، در تجاری سازی علم و کارآفرینی نیز فعال هستند که با توجه به شرایط موجود از لحاظ اشتغال دانش آموختگان و یا خودکفایی مالی دانشگاهها، ورود به نسل سوم دانشگاهها یک ضرورت است. زمینه های تحقیقاتی میسر در الکتروشیمی توانایی زیاد این علم در "*کارآفرینی در مرز دانش*" را نشان می دهد. در این سخنرانی سعی شده است فعالیت های علمی محققان کشور در زمینه الکتروشیمی مورد بررسی قرار گیرد و به بررسی مقالات چاپ شده توسط آنها با مقالات دیگر محققان دنیا پرداخته شود. نقاط ضعف و قوت فعالیتهای علمی انجام شده در کشور در زمینه الکتروشیمی و توانمندی دانش اموختگان آن در کار آفرینی مورد بررسی قرارگیرد.

Electrochemical biosensors based on functionalized magnetic nanoparticles

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Nowadays, magnetic nanoparticles represent an interesting material because of the unique properties such as electrical and magnetic properties. They are widely used to improve the electron transfer of the electroactive species at electrode surfaces. Nanoparticle modified electrodes show an apparent increase in active surface area and signal to noise ratio in electrochemical systems. However, it is possible to increase the selectivity and sensitivity of the electrodes by using functionalized nanoparticles. In this way, the aim of the first part of this work was to synthesize of magnetic iron oxide nanoparticles functionalized with cytochrome c (MNPs-Cyt) using co-precipitation method. In the second part of the work, the electrochemical behavior of phenolic compounds was investigated using a carbon paste electrode modified with MNPs-Cyt via surface adsorption. The results showed that the modified electrode inan aqueous solution, can be applied for determination of phenol and catechol in the concentration range of 1.0 to 16.0 µM with a detection limit of 0.60 µM.

High-performance supercapacitors and their applications

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In this energy-dependent world, electrochemical devices for energy storage play a vital role in overcoming fossil fuel exhaustion. Among various electrochemical energy storage devices, supercapacitors have attracted significant interest in both academic and industrial studies during the past several decades owing to their superior power density, fast charge/discharge rate and long cycle life [1]. Based on different energy storage mechanisms, supercapacitors are divided into several types: electrochemical double layer capacitors (EDLCs), pseudo-capacitors and hybrid capacitors [2]. In EDLCs, electrical energy is stored by electrostatic accumulation of charges. Electrochemical performances of EDLC electrodes are almost emanated from their electrical conductivity, pore structures and specific surface area. While for pseudo-capacitors, the energy storage is achieved through reversible and fast redox reactions. Up to now, a wide variety of electrode materials have been developed, such as carbon materials, metal oxides/hydroxides, metal sulphides, metal phosphides and electrically conducting polymers. Along these research's, our group prepared electrode materials based on metal oxides [3], metal sulphide [4] and metal phosphides [5] for supercapacitors.

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Electrosynthesis of the Metal-Organic Framework Thin Films

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In this general lecture, we will take a glance at the recent developments in the electrochemical synthesis and deposition of the metal-organic framework thin films (MOFTFs). MOFs that have been introduced owing to the untiring endeavors of Yaghi and co-workerson the science frontier and followed by BASF in the industrial areaare attractive materials for the modification of electrode, membrane and transducer surfaces. Although the MOFs have been known as green materials for sustainable goals, the eco-friendly synthesis of them as thin layer films are still challenging and open discussion. Tunable porosity, large surface area, catalytic effect, and structural diversity are prominent, but on the other hand, fragility and brittle or insolubility of most bulk MOF crystals are deficiencies of these compounds for modification of surfaces. To overcome these drawbacks, considerable scientific efforts were devoted to stabilization of MOFs as thin films. From a comprehensive perspective, two general categories can be mentioned; ex-situ and in-situ techniques. The former methods need to transfer of synthesized MOFs onto the substrate and therefore are less acceptable than the in-situ, or direct growth/deposition techniques with an intergrowth and integrated thin films. Meanwhile, electrochemistry is still a niche and unique platform to address the interfacing issue of MOFs with the underlying surface. This positive glance comes from the mild, one-step, selective and controllable strategy that would lead to the simultaneous synthesis and deposition of uniform films. Among the electrochemistry approaches that have been dedicated toward the in-situ/direct modification, anodic and cathodic techniques for microporous and mesoporous MOFTFs are easy on the eyes. In the anodic method that electrode plays the role of cation source, non-blocking of pores by salt and controlling of metal oxidation state are its beneficial features. However, restriction on the anode material selection and single-phase MOF conformation are limitations of the anodic method. In contrast, a cathodic method with the advantages such as free-choice of electrode material, in-situ deprotonation of ligand, availability of cation and multiple phase MOF fabrication, has been adopted based on salt as a cation source. However, the possibility of metal reduction and pore blocking by salt are the main limitations of cathodic method. Electrophoretic deposition is another technique for the growth of MOFTFs onconductive surfaces by employing of DC electric field toa suspension of charged particles in a nonpolar solvent. Also, the microfluidics systems allow the continuous production of MOFs and synthesizingMOF-based hollow fiber membranes. Recently the electrochemically assisted self-assembly technique provides a general procedure for the simultaneously synthesis and deposition of mesoporous MOFTFs by electrochemically driven co-operative reaction of SDA, ligand and cation with the perpendicularly aligned 3D hollow hexagonal microcrystals onto the electrode surface, with 2D hierarchical honeycomb-like mesopores in the wall of cavities.Another disadvantage of above-mentioned methods is ignoring the counter-electrode reaction, which causes some remarkable issues like energy consumption, time-saving and costing to be ignored. Recently, the paired electrodeposition technique is introduced as a novel paradigm for the simultaneous synthesis and deposition of the MOFTFs with emphasis on the economic aspects. The implementation of this protocol would direct two MOFTF modified electrodes by convergent and divergent paired electrodepositionthrough the one-step synthesis.

In this regard, this review aims to summarize the strengths, shortcomings, and an outlook for future research on the electrosynthesis of MOFsand to provide a full picture of thisfield.

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Recent advances in Bio-Analysis Lab for development of electrochemical biosensors and biofuel cells

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Bio-receptors such as enzymes, antibodies, nucleic acids, tissues or even single cells, when incorporating with nanotechnology, are able to transact the signal to a specified physical transducer. This process beside the specificity of the bio-receptors toward their targets could be the origin of the technologies such as enzyme electrodes, biosensors and biofuel cells. So far, we have developed different typesof nanocomposites consisting of carboxilic acid or amine functionalized single/multi-wall carbon nanotubes either alone or incorporating with the metallic nano-particles such as gold, silver, gold-silver alloy, TiO_2, or room temperature ionic liquids. In this way, the electrical conductivity, electron transfer rate and the reversibility of the redox proteins were improved and consequently the signal transduction in electrochemical biosensors were increased. Such a modified electrode was applied for enzyme based voltammetric biosensors, ultra-sensitive immunosensor for detection of hepatitis B virus and microbial fuel cell as well. For developing microbial biofuel cell, *Shewanella* algae were grown anaerobically on the woven carbon fiber filament coated with a nanocomposite consisting of NH_2-MWCNTs and RTILand used as a bioanode. As conclusion**,** combination of different types of nanomaterials, developed in the Laboratory of Bio-Analysis, and bio-receptors led to introduce the new methods for development of biosensors and enzyme/microbial biofuel cells.

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Ultrasensitive electrochemical aptasensors for biomedical applications

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Biological recognition probes such as synthetic receptor is one of the candidate recognition layers to detect important biomolecules (such as drugs, amino acids and cells). In recent years, in order to detect specific molecular targets and solve many challenges, a new class of ligands called aptamer is known. Aptamers are single strand oligonucleotides that can bind with high affinity and specificity to different kind of targets, from small molecule to intact cells. Aptamers possess several advantages that make it an ideal biosensing element such as improved temperature stability, shelf life, easy synthesis, flexible to modification, easy storage, low toxicity, more stable to biodegradation and high binding tendency and selectivity [1]. Among various aptamer-based biosensors, electrochemical aptasensors have received an increasing amount of attention for detection of analytes due to their high sensitivity, simplicity, portability, low expense and rapid response for molecular detection [2]. In recent decades cancers are the main reasons of fatalityin the worldwide. Howbeit serious advance has been made in cancer therapy, they are still considered as the main reasons of mortality. Early diagnosis of cancers can reduce mortality and is very important for a successful therapy [3]. The aim of this study is to investigate the biochemical applications of electrochemical aptasensors, in particular, early detection of cancers.

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Electrochemical biosensors based on nucleic acidsfor the study of DNA damage

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Electrochemical DNA biosensors are integrated receptor-transducer devices that use DNA as biomolecular recognition element to measure specific binding processes with DNA, by electrical signal transduction at the surface of an electrode as transducer [1,2]. Usually, two kinds of electrochemicalmethods are adapted to detect DNA damage, which are based onthe direct oxidative signals of DNA bases or indirect electrochemical indicators [3]. Detection and prevention of DNA damage are important in the prevention and treatment of many diseases. Hence, the development of simple and sensitive tools to detect of DNA damage has attracted the attention of many researchers. Recently, weused the electrochemical DNA biosensors based on nucleic acids as effective tools for detecting and preventing of DNA damage. In this area, weconstructed a novel label-free electrochemical biosensor for ultrasensitive detection of DNA damage based on the use of Au nanoparticles modified screen-printed gold electrode. Then, we immobilized the thiolated DNA on the surface of the modified electrodeand used Fenton's reaction to damage of DNA.Hence, the study of DNA damage caused by this system is important. To cause damage in DNA by Fenton reaction, the prepared biosensor was placed in damaging solution (TBS (0.1 M, pH=7.0) containing ($CuSO_4.5H_2O$ (2.5×10^{-8} M), H_2O_2 (2.5×10^{-4} M) and ascorbic acid (1.0×10^{-6} M)) for 1 hour and then the Nyquist plot were examined before and after exposure to the damaging solution.Also, to investigate the protective effect of deferoxamine (DFO) in preventing DNA damage, Nyquist plots of the prepared biosensor were recorded beforeand after exposure to the damaging solution, in the absence and presence of DFO. The obtained results indicated the antioxidant effect of DFO in prohibiting of DNA damage [3].In another study, weconstructed a new DNA biosensor based on immobilization of breast cancer 1 gene on Diazonium-modified screen-printed carbon electrode (SPCE).Electrochemical impedance spectroscopy and differential pulse voltammetry were used for the detection of DNA damage induced by Fenton reagent, by monitoring the changes in charge transfer resistance (R_{ct}) and the oxidation peak currents of methylene blue as an intercalating indicator [4].

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Application of Scanning Vibrating Electrode Technique (SVET) on elucidating the mechanism of stress corrosion cracking of 304L stainless steel

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Stress corrosion cracking (SCC), as a prevalent type of failure in industrial equipment, consists of two major steps i.e: crack initiation and its growth, which are surface correlated. It is believed that the cracking starts from the depth of corrosion pits formed on the surface due to the presence of chloride ions. The exact mechanism of the phenomenon is not yet clearly found due to the correlating presence of metal, environment and stress. Scanning vibrating electrode technique (SVET) is a powerful micro-electrochemical technique that can be used for localized investigation of corrosion process [1] which has been widely used in many studies on various topics of corrosion [2-4] as well as electrochemical science. In this work, scanning vibrating electrode technique is employed as a novel and localized tool to monitor the crack propagation during stress corrosion cracking of 304L stainless steel at ambient temperature under constant load. The results obtained by SVET maps showed that cracking initiated from the activated notched area where the applied stress concentrates and as a result encompasses a large number of slip steps. Crack propagation is stepwise with repetitive activation and deactivation demonstrated by change in anodic current which forms periodically on the notched area and also moves forward while the area behind it becomes inactive or passivated. Therefore, it is not the crack tip only but the crack tip area which becomes anodic facilitating crack propagation. SVET on aluminum alloy showed similar results indicating active potentials on active pits which were deactivated by using corrosion inhibitor on the surface. The surface showed a uniform potential all over the surface as a result of corrosion inhibitor.

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Impedimetric sensors and biosensors for direct determination of some biologically important compounds

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Analysis of biologically important compounds is performed with clinical, forensic, toxicological, pharmacological, and research contexts. A considerable amount of research has been performed in recent years in order to improve the present analytical methods or introduce new methods for rapid, sensitive, and accurate determination of biologically important compounds. Direct and label-free analytical method for the biological compounds is of great importance due to faster analysis time, lower limit of detection, and the need for smaller sample volumes. In the recent years, electrochemical sensors and biosensors have become more preferable due to their low cost, portability, miniaturization possibility, flexibility, and sensitivity. In addition to these characteristics, biomolecules (antibody and aptamers) immobilized onto the surface of electrochemical conductive biosensing platforms provide high specificity for detecting of target analytes. Impedimetric sensors and biosensors were prepared and used for the direct and label-free determination of botulinum neurotoxin serotype A, cocaine, ampyraand non- Hodgkin's lymphoma (NHL) cancer cells. The sensing probes were prepared by the proper electrodes. The modification steps were followed by electrochemical, spectroscopic and microscopic methods. The modified electrodes were used to determine the target analytes in real samples with satisfactory results.

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High Performance Lithium-Ion Batteries: Application of Plasma Polymerization on Cycle Life and Capacity of the Cells

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Lithium-ion batteries are of high technology devices in modern energy storage. In general, lithium-ion batteries contain cathode, anode, separator and electrolyte [1]. After the assembly of the cell, an electrochemical process, this is called "formation process", makes the cells ready for use [2]. Any of the battery components and the formation process is critical for the performance of the cell and can affect the capacity and the cycle life. Separator is a significant component in lithium-ion batteries. The most popular separators, which are used in lithium-ion batteries, are porous polyolefin membranes [3]. Polyolefin membranes have good mechanical, physical and chemical stability. However, these separators lack a number of disadvantages including electrolyte retention, which is a result of the low compatibility with carbonate electrolyte solutions [4]. In this report, in situ plasma polymerization of acrylate monomers on the surface of commercial polyolefin separators is reported. For this purpose, separator is immersed in acrylate monomer solution and then exposed to cold plasma. Different variables including the monomer concentration, exposure time, plasma power and etc. are optimized. The results showed that, immersing the polyolefin membrane in 20% wt. solution of methyl methacrylate and polymerization by plasma in 300 V power gave the best performance separator. The modified separator increased the initial capacity and the cycle life of lithium-ion batteries.

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Electrocoagulation process for recycling of industrial wastewater: laboratory and semi-industrialstudies

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The world faces a water scarcity crisis. In recent years, due to the excessive consumption of water resources and climate change, cities and countries confront the severe water shortage. This problem has passed the warning stage, and many countries, like Iran, now face a serious challenge of supplying water. Consequently, the reuse of wastewater, which contains more than 80% of water concumed in communities and Industry, results in less harvesting water resources [1]. The purpose of this study was to investigate the applicability of the electrocoagulation (EC) method in a laboratory and semi-industrial pilot scales for recycling water with agricultural and industrial quality from the Bu Ali Industrial Town wastewater treatment plant (WWTP) effluent. First, on a laboratory scale, the influence of operational parameters such as current density (CD), retention time and type of electrode (aluminum and iron) on the amount of chemical oxygen demand (COD) and total suspended solids (TSS) removal was investigated. The results showed that COD and TSS removal efficiency increased with increasing CD and retention time. Of course, it should be noted that, in the final evaluation of these parameters, the operational costs, electrode consumption costs and electrochemical energy consumption should be considered. The laboratory pilot scale had a high efficiency in the treatment of wastewater and produced an effluent with TSS and COD lower than 50 mg L^{-1} under the following optimum conditions: detention time= 20min, CD= 0.24 mA $cm^{-2}$and pH=7±1. Based on experimental results, a pilot plant with a volume of 200 liters was manufactured. The findings obtained were almost similar to laboratory studies. There is no need to use chemicals to wastewater recycle by using the EC method and the operating costs are related to the cost of electricity and electrode consumed [2-3]. Aluminum electrode consumption was less than iron electrode [2], so that, for the recycle of each cubic meter of wastewater, the electrode consumption was 0.33 and 0.26 grams, respectively, for iron and aluminum anode. Also, the cost of daily electricity consumption (to recycle 500 m^3 of effluent from the Bu Ali Industrial Town WWTP) is approximately 0.85 and 1.44 million rials, respectively, for iron and aluminum electrode. Overall, the EC process is useful for the treatment of wastewater and effluent reuse for industrial and agricultural purposes.

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Simultaneous electrochemical detection of cadmium (II), lead (II), copper (II) and mercury (II) ions using MMT/NiO/ZnO/GCE

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The simultaneous detection of trace metal ions at very low concentration levels using inexpensive, fast and easily operative instrumentation is interesting topic because these methods can save time; reduce the cost of analysis and has the ability to analyze multi-elements [1]. Stripping analysis has been demonstrated to show significant sensitivity toward heavy metal ions detection. Anodic stripping voltammetry (ASV) is the most effective and widely used technique, in which the heavy metal ions were predeposited onto the electrode surface and afterward detected by stripping step [2,3]. Here in, a sensitive electrochemical platform for the simultaneous determination of Cd^{2+}, Pb^{2+}, Cu^{2+} and Hg^{2+} ions. has been constructed based on montmorillonite (MMT)/NiO/ZnO modified glassy carbon electrode using anodic stripping voltammetry (ASV). The morphology and properties of electrode surface were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM) and Fourier transform infrared spectroscopy (FTIR) techniques. Under the optimal conditions, the limit of detection was estimated to be 0.34, 0.12, 0.07, 0.22 μg L^{-1} for Cd^{2+}, Pb^{2+}, Cu^{2+} and Hg^{2+}, respectively.

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Electrochemical sensor for simple and sensitive ultra-trace detection of sunitinib in different samples

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The electrochemical methods using glassy carbon electrode (GCE) have been widely used as sensitive and selective analytical methods for the environmental, clinical and bio technical analysis [1]. Using of electrochemical sensors and biosensors is increase so much for biological and environmental samples. Because they have so many advantages like very low background current, low cost and simple method, large potential window, simple surface renewal process, easiness of miniaturization, good linearity range and good limit of detection [2,3]. Sunitinib (SUN) has proven efficacy as a single agent in several solid tumor types and is approved for use in advanced renal cell cancer and imatinib resistant or imatinib-intolerant gastrointestinal stromal tumors [4]. SUN was recently approved for the treatment of advanced renal cell carcinoma and for the treatment of gastrointestinal stromal tumors after disease progression or intolerance to imatinib mesylate therapy [5]. We are introducing a new sensor for trace determination of SUN in different samples. The electrochemical response characteristic of the GCEtoward SUN was investigated by cyclic and square wave voltammetry (CV and SW). Electrochemical studies were carried out in a glass cell incorporating three electrode configuration containing 25 mL, 0.1 M phosphate buffer solution (pH 7.0) as running electrolyte, powered by a CompactStativium. The working electrode used in the voltammetry experiments was a GCE (without any accumulation time) and a platinum wire was used as the counter electrode and reference electrode was saturated calomel electrode. The figures of merit of proposed sensor and the other methods was reported in table. As shown in the table, the response of proposed sensor under the optimized conditions was acceptable. The RSD of five replicate experiment was 1.5%.

system	Conc. Range	LOQ	LOD	Reference
HPLC-MS/MS	6.27 to 1250 nM	6.27nM	1.9 nM	[4]
HPLC-UV-visible	50.2 to 502 nM	50.2 nM	15.21 nM	[5]
Electrochemical	15 to 120 nM	15 nM	4.54 nM	This work

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Developing an electrochemical genosensor based on 4,4'-dihydroxybiphenylelectroactive label

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A quick and suitable voltammetric assay was constructed for highly sensing detection of short sequences related to cancer biomarker (miR-25) [1-2] using an amino-functionalized graphene quantum dot modified GCE [3] as anamplifier the electrochemical signalsand suitable substrate for DNA immobilization which characterized by TEM. All stages of the fabrication of this genosensor were confirmed by CV and EIS. The sensing mechanism is based on the significant variation in differential pulse voltammetric response of accumulated 4,4'-dihydroxybiphenyl (PBP), as a novel electroactive label, on the ss-probe and ds-DNA. The results indicated that the electrode can distinguish complementary miR-25 from a single-base mismatch. The increase in the electrochemical response of PBP and the positive shift in the potential peak indicate that PBP is intercalated between two strands. In optimized experimental conditions was established that the response of proposed genosensor was linearly depended on the logarithmic miR-25 concentration over the range 0.3 nM to 1.0µM by equation y = 0.1111 x + 1.1296 and detection limit was 95.0 pM. The assay was successfully employed to the determination of miR-25 even if there is a miRNA comprising a single-base mutation in spiked human plasma.

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Highly sensitive determination of Epinephrine using threedimensional NiO Nanowrinkles /Glassy-Carbon Electrode

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Epinephrine is used for emergency treatment of severe allergic reactions (including anaphylaxis) to insect bites or stings, medicines, foods, or other substances. It can also be used in the treatment of idiopathic anaphylaxis (unknown cause) or exercise-induced anaphylaxis. When given intramuscularly or subcutaneously it has a rapid onset and short duration of action in addition to the above function. Epinephrine is the primary drug administered during cardiopulmonary resuscit [1]. Electrochemical sensors and biosensors for pharmaceutical, food, agricultural and environmental analyses have been growingrapidly due to electrochemical behavior of drugs and biomoleculesand partly due to advances in electrochemical measuring systems. The merger between fast, sensitive, selective, accurate, miniaturizable and low-cost electrochemistry-based sensing andfields like proteomics, biochemistry, molecular biology, nanotechnology and pharmaceutical analysis leads to the evolution ofelectrochemical sensors. Nanostructured materials have attracted considerable interests and have become a vast area of research owing to their unique physical and chemical properties which can provide an important and feasible platform for electroanalysis particularly in the design of modified electrodes for electrochemicalsensing [2]. In the present work, the preparation of an electrodes modified with nanosized three-dimensional NiO nanowrinkles and its function for the determination of epinephrine are investigated. The diffusion coefficient, and the kinetic parameter such as the electron transfer coefficient of epinephrine oxidation at the surface modified electrode was determined using electrochemical approaches. It has been found that under an optimum condition (pH 7.0), the oxidation of epinephrine at the surface of such an electrode occurs at a potential about 120 mV less positive than that of an unmodified electrode. Under optimum conditions, modified electrode exhibited linear dynamic rang from 0.2 to 800.0µM with detection limit of 0.08µM.

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Development of a silver nanoparticles-functionalized multi-walled carbon nanotubes sensor for lead ion determination by anodic stripping voltammetry technique

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Lead is one of the ubiquitous toxic metals known to man [1]. The rapid, sensitive, and simple determination of the metal ions is of prime concern in the biosphere due to their high toxicity to human health [2]. In the present study, a novel and efficient method for the preconcentration and determination of lead ion was presented by using differential pulse anodic stripping voltammetry method. A glassy carbon electrode was modified with silver nanoparticles-functionalized multi-walled carbon nanotubes (Ag NPs/MWCNT/GCE) to determine lead ion by (DPASV) method. Silver nanoparticles were electrochemically deposited on the glassy carbon electrode then functionalized multi-walled carbon nanotubes (dispersed in dimethylformamide) were dropped on the electrode surface. An anodic peak was observed at -0.48 V, which is related to the oxidation of accumulated and reduced pb (II) on the electrode surface. The effective parameters on deposition and stripping of metal ions, such as pH, deposition potential, and deposition time, were optimized. The deposition potential of -1.0 V vs Ag/AgCl for 400s was used as optimum deposition potential and time. The DPASV of Pb^{2+} ions showed a linear range from 0.0005 to 0.5 µM (R=0.996). The developed protocol has shown a limit of detection (LOD) of about 0.4 nM and the relative standard deviation (RSD) of 2.87%. Selectivity of the electrode towards Pb^{2+} ions were tested in presence of potential interferences such as Na^{+}, K^{+}, Ca^{2+}, Mg^{2+}, Cu^{2+}, Cd^{2+}, Zn^{2+}, Co^{2+}, Ni^{2+} and Fe^{2+} of similar and higher concentrations. The modified electrode was applied successfully for the analysis of lead ion in various real samples including blood serum. Therefore, a new and simple method for lead ion determination in patients is presented.

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Voltammetric PSA sensor based on the use of graphene oxide@polyanilline, and molecular imprinted polymer

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Prostate cancer is a disease that is characterized by the value of prostate specific antigen (PSA) as a biomarker. In general, it is reported that a man could be suspected to prostate cancer, when a total PSA level in their blood is higher than 4 ngmL^{-1} [1] or 10 ngmL^{-1} [2]. While in the female this value of PSA level is lower than10 pgmL^{-1}. This value is 1000-fold less than the value of PSA in male [3]. So, in order to provide proper treatment at the early stage and saving the patients early diagnosis and timely therapy can be useful [4]. This paper focuses on a sensitive and selective electrochemical method to detect PSA by using molecularly imprinted polymer (MIP). A composite of graphene oxide - poly aniline (GO@PA) has been introduced into the electrode. In the MIP sensor, GO@PA on the surface of modified electrode is employed to immobilize PSA to the surface of the electrode and dopamine is used as a monomer to capture PSA in the polymer matrix. To follow the electrochemical signal under the optimum condition differential pulse voltammetry is used as a simple and sensitive detection. The detection range for the determination of PSA was obtained in the concentration of PSA in the range of 25 pg mL^{-1} to 2.5 ng mL^{-1}. Also the designedGO@PA-MIP sensor showed the application of this method for early diagnosis of prostate cancer.

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Application of aglassy carbon electrode modified with CuOnanoflowersfor Voltammetric determination ofisoproterenol

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Compared with other transition metal oxides, copper oxide (CuO) has attracted wideattention due to is lower toxicity, lower cost and desirable electrochemical properties [1]. Until now, CuO materials with different structures, morphologies and dopedcomponents have been investigated as electrode materials for sensing application [2]. Isoproterenol (IP) or 4-[1-hydroxy-2-[(1-methylethyl)-amino] ethyl]-1, 2-benzenediol isa drug which used for the treatment of primary pulmonary hypertension and allergicemergencies, bronchitis, cardiac chock and heart attack. But, the excess of the drug may cause heart failure and arrhythmias [3]. Due to the advantages of low cost, fast response, simple instrumentation a high sensitivity voltammetric method for determination of isoproterenol have been developed [4].

In the work, a sensitive and selective electrochemical sensor based on CuOnanoflowers for detection of isoproterenol in the presence of theophylline has been successfully developed. The electrochemical characteristics and catalytic behavior of prepared electrode for the determination of isoproterenol were systematically investigated by cyclic voltammetry (CV) and differential pulse voltammetry (DPV). At the surface of modified electrode, the oxidation of isoproterenol occurred a potential about 200 mV less positivecompared to the bare electrode. Under optimum conditions, the CuO/ GCE exhibits linear response toisoproterenol in a wide dynamicrange 0.1- 500.0μM, with detection limit (S/N = 3) calculated to be 0.03μM. Finally, the developed sensor was successfully applied to the detection of isoproterenol injection and urine samples with satisfactory results.

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Titania-Ceria-Graphene Quantum Dot Nanocomposites as New Modifiers for Determination of Dopamine in The Presence of Ascorbic Acid and Uric Acid

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Dopamine (DA) is one of the most important neurotransmitters in the mammalian brain that has a substantial role in the function of the central nervous, renal and hormonal systems. Various analytical techniques have been used to determine of DA [1]. However, due to electroactivity of DA, the electrochemical methods appear to be suitable for its quantitative determination. Nowadays, new nanomaterials are being used in the construction of the new electrodes for electrochemical sensing of DA [2-3]. A sensitive and selective DA sensor based on Titania-Ceria-Graphene Quantum Dot (TC-GQD) nanocomposite modified glassy carbon electrode (GCE) are presented for the first time, here. Graphene quantum dots (GQD), Titania-Ceria (TC) and TC-GQD nanocomposites were synthesized by hydrothermal and sol-gel methods [4-5], and then characterized by FTIR, FESEMandEDS techniques. The electrochemical responses of the GQD (GQD/GCE), TC (TC/GCE) and TC-GOD(TC-GQD/GCE) modified GCE towards DA, ascorbic acid (AA) and uric acid (UA) were evaluated by using CV and DPV techniques, and also affecting parameters like pH on their response were studied and optimized for each electrode. Selectivity of the prepared electrodes towards DA, linear ranges, figure of merits and detection limits of the electrodes calculated and compared with together in this work and will be presented and discussed. Our findings showed that the electrochemical sensor based on TC-GQD/GCE, successfullydetected DA in the presence of AA and UA, in the wider linear range, 1-500µM, and lower detection limit, 0.22 µM, than the other electrods in this work.

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MnO_2 nanosheets: simple and green synthesis and their electrocatalytic activity in reduction of hydrogen peroxide

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Manganese oxide (MnO_2) nanostructures have been regarded as one of the most promising inorganic materials due to its low cost, abundance and fascinating catalytic properties. Manganese oxide is among the strongest oxidants and has many polymorphic forms such as α, β and γ type which show distinctive physical and chemical properties. According to literature, synthesis methods such as hydrothermal synthesis, sol gel process, electrodeposition method and template method have been devoted to obtain MnO_2 with a desired morphology. Due to good electrocatalytic properties and wide potential window MnO_2 nanostructures have been greatly applied in the field of electrochemical sensing of various analytes. In this study, manganese oxide (MnO_2) nanosheets were successfully synthesized by a simple, green and low-cost method in the presence of Gum Arabic as both template and reducing agent in the absence of other additives. The morphology, crystalline structure and composition of the prepared MnO_2 nanosheets were studied by Field emission scanning electron microscopy (FESEM), transmission electron microscopy (TEM), X-ray diffraction spectroscopy (XRD) and energy dispersive X-ray spectroscopy (EDX). The FESEM and TEM images show that the as-prepared MnO_2 exhibits wrinkle-like nanolayer morphology. Then, the electrochemical performance of the prepared MnO_2 was investigated for the detection of hydrogen peroxide (H_2O_2). The electrochemical H_2O_2 sensor based on MnO_2 nanosheets modified carbon ionic liquid electrode (MnO_2/CILE) was fabricated by a pasting method and its electrocatalytic behavior was investigated using cyclic voltammetry and amperometry. Compared with the bare CILE, the MnO_2/CILE electrode exhibited good electrocatalytic activity toward H_2O_2 reduction in alkaline solutions. The fabricated nonenzymatic H_2O_2 sensor also showed a linear relationship over an extensive concentration range of 5.0 µM to 10.0 mM ($r^2 = 0.998$), with a response time of less than 5 s and a detection limit of 1.0 µM. In addition, the developed electrochemical sensor displayed excellent anti-interfering ability, good reproducibility and also good recovery on the detection of H_2O_2 in real samples.

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Construction of modified glassy carbon electrode using a hexagonalCe^{3+}/NiO nanoparticle for measuring methyldopa

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Methyldopa (α- methyl- 3,4- dihydroxy- L- phenylalanine) is an analogue of dopamine and affects the central nervous system to lower the blood pressure and which is especially prescribedto treat hypertension in the elderly, patients with renal insufficiency and during pregnancy. Methyldopa seems to be associated with a wide range of adverse events such as central nervous system depressant effects (lethargy, drowsiness and depression), hepatitis, myocarditis, dry mouth and haemolyticanaemia [1]. Electrochemistry at the nanoscale has embraced numerous fields of research ranging from the investigation of processes inside biological cells to the evaluation of functional materials in the shape of single nanoparticles. [2] some carbon materials have been depicted as particularly promising for building costeffectivesensors devices, since they show good conductivity, electrochemical stability, and long-life cycle [3].
In this work, measuring methyldopa by glassy carbon electrodes modified with Ce^{3+}/NiO hexagonal nanoparticles using cyclic voltammetric technique, square wave voltammetry and chronoamprometry techniques.It has been found that under an optimum condition (pH 7.0), the oxidation of methyldopa at the surface of such an electrode occurs at a potential about 210 mV less positive than that of an unmodified electrode.Under optimum conditions, modified electrode exhibited linear dynamic range from 0.09–500 µm with detection limit of 0.03µm.

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Direct electron transfer of glucose oxidase and biosensingfor glucose on carbon nanofibers (CNFs) and N-doped graphene quantum dots (NGQDs) composite

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Glucose oxidase (GOD) is a flavin enzyme with FAD (flavin adenine dinucleotide)/FADH2 as the redox prosthetic group (active center) [1, 2]. GOD has been successively employed to fabricate glucose biosensors. Constructing an enzyme-labeledelectrochemical glucose biosensor may possess some prominent advantages over nonenzymatic sensors, includingmuch higher electrocatalytic activitytoward analyte [3, 4]. The most widely used technique for enzyme glucose sensors is amperometry [5]. In the amperometric sensors, GOD oxidizes glucose to gluconic acid in the presence of oxygen. however, in hydrodynamic amperometric condition, the concentration of oxygen changes during the rotation of the electrode and maintaining a stable oxygen concentration becomes difficult. In the present work, an enzyme labeled electrochemical biosensor was fabricated for sensitive glucose detection. A hybrid nano-interface comprising a blendof carbon nanofibers (CNFs) and N-doped graphene quantum dots (NGQDs) was employed as anovel immobilization platform for glucose oxidase (GOD). The new nanocomposite can provide a larger surface area and favorable direct electron transfer between GOD and the electrode. The GOx immobilized on CNFs-NGQDs composite exhibits well-defined redox peaks with a peak potential separation (ΔEp) of about 30 mV with enhanced peak currents, indicating a fast electron transfer at the modified electrode surface. The optimization of the amount of nanocomposte, temperature and enzyme concentration were performed in detail. Differential pulse voltammetry (DPV) was employed to investigate the determination performance of the enzyme biosensor, resulting in a linear response range from 1.0 to 15.0 mM with an optimal detection limit of 0.15 mM. and the practicality of this sensor has been demonstrated in human serum samples, providing great potential in clinical applications.

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Voltammetric determination of ascorbic acid by electrografting of hydroquinone on glassy carbon electrode

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In this work, a new sensor based on electrografted of hydroquinone on the surface of a glassy carbon electrode ((HQ/GCE) was developed for the catalytic oxidation of ascorbic acid (AS). The modification of electrode is done through nitration of hydroquinone by nitrous acid and electroreduction of generated nitrocatechol which results to grafting of hydroquinone [1-3]. We described the electrochemical behavior of ascorbic acid (AS), at the bare and hydroquinone electrografted glassy carbon electrode (HQ/GCE), using cyclic voltammetry as a diagnostic technique. The results indicated that the HQ/GCE, exhibits high electrocatalytic activity toward AS. By means of the chronoamperometry method, moreover, the present study estimated the diffusion coefficient of ascorbic acid and the catalytic rate constant of the reaction of electrografted of hydroquinone reaction with ascorbic acid. The proposed method was successfully used for the determination of AS in serum samples.

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A chromium-based metal-organic framework modified glassy carbon electrode as a new sensor for the sensitive determination of codeine

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A new class of crystalline porous materials, Metal-Organic Frameworks (MOFs), provides a chance for combine the inorganic building units and organic linkers to make a great material for substances detection, because of their high selectivity, quick-response, operability and reversibility [1]. Hence, in this study, Cr(III) based metal-organic framework (MIL-101-NH_2) were prepared by hydrothermal pathway without any surfactants and developed and validated as Codeine sensor using cyclic voltammetry (CV) and differential pulsed voltammetry (DPV) methods [2]. The characterization of the synthesized MOF has been carried out by means of Field Emission Scanning Electron Microscopy (FE-SEM), powder X-ray diffraction, thermo gravimetric analysis (TGA), elemental analysis, FTIR spectroscopy and electrochemical impedance spectroscopy (EIS).The chromium-based MOF modified electrode was highly selective to Codeineand it was shown a wide linear range from 0.5 to 200 µM, with a detection limit of 0.15 µM (n=5, S/N=3), revealing the high-sensitivity properties.Finally, the proposed method was successfully applied to determine Codeine in urine samples.Due to the advantages of the sensor, its sensitivity, stabilityand selectivity, it will have a bright future in the field of medical diagnosis.

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Construction of a new Molecular Imprinted Carbon Paste Electrode for Selective determination of Ethyl Carbamate

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Ethyl carbamate (EC), known as urethane, is an ethyl ester of carbamic acid and has been recognized as a well-known multi-site carcinogenic compound, causing the incidence of cancer especially in lung, blood vessels and liver based on animal experiments [1]. Genotoxic and carcinogenic effects have been confirmed in many species including rats, mice, hamsters and monkeys [2]. National Toxicology Program (NTP) revealed the probable carcinogenicity of EC to humans. It is naturally formed in fermented foods during fermentation process and/or during storage. Furthermore, EC has been detected in various fermented products such as bread, yoghurt, cheese, soy sauce, and vinegar [3]. The previous investigation have indicated that EC production is due to the natural biochemical processes e. g reaction of ethanol and nitrogen-containing compounds, such as urea, carbamyl phosphate and cyanide [4]. There are different methods to the detection of EC but more of them are based HPLC technique that is expensive and time consuming. It is crucial to present a new cost effective and simple method toEC detection. Molecular imprinting is a simple and well-established methodology to prepare materials with recognition sites for specific molecules that is pioneered more than thirty years ago [5]. The MIP material acted as a recognition element of the sensor and can be used for specific recognition of target molecules owing to the binding sites complementary in size and shape to the templates. In electrochemical sensors, MIPs cannot only accumulate template molecules on the electrode surface to enhance the sensitivity, but also separate template molecules from the other analytes to improve the selectivity. In this work, carbon-paste electrodes (CPE) modified with MIP was used for the sensitive electrochemical determination of Ethyl carbamate (EC). The electrodes are prepared by mixing a graphite powder, paraffin oil, and distinct amount of MIP powder, which was synthesized previously. The electrochemical response characteristics of these modified electrodes toward EC were investigated by cyclic voltammetry and square wave Voltammetry. Prior to established detection method, experimental parameters were optimized. The optimization time was 20 min and pH was 5. The changes in current before and after analyte loading recorded and used as analytical response. The sensor showed a good linear response in phosphate buffer pH=5 toward EC in the range of 0.1–500µM with LOD 0.01µM and RSD 3.2%. Our result is comparable with previous researches that reported by Ming Guo in 2018, Xiaoyu Zhao in 2017 and Zhiwei Zhang in 2016. They represented the methods based on MIP and enzyme which indicated a linear range of 100 to 1300 nM, 100 to 1300 nM, 0.5 to 40µM, respectively. For these works, the reported LOD were 0.065µM, 37nM and 5.30 nM, respectively.

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Oxidation of ethanol using a new MWCNTs–TiO_2–Au-Ptphotoelectrocatalyst

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Direct ethanol fuel cells (DEFCs), as eco-friendly energy conversion devices; have drawn increasing attention because of their high energy conversion efficiency [1]. In order to develop the DEFCs technology, it's an importance to access a highly active catalyst for the ethanol oxidation reaction because of the complete oxidation of ethanol into CO_2 needs 12 electrons and the cleavage of the C-C bond. Currently, Pt-based nanostructures are selected to be the most effective electrocatalysts [2]. Unfortunately, the high-cost of Pt as well as easily to be poisoned by the reaction intermediates (such as CO) are the main problems [3]. In this research project, a new photoelectrocatalyst was prepared for electrooxidation of ethanol using multi wall carbon nanotubes (MWCNTs), titanium dioxide (TiO_2) and platinum-gold (Pt –Au) nanoparticles. In order to prepare the photoelectrocatalyst, a certain amount of MWCNTs and TiO_2 suspension was injected on the surface of flourin tin-oxide (FTO) plates and then the surface was coated with platinum and gold nanoparticles. The morphology and microscopic structure of the surface of the modified electrodes were characterized by scanning electron microscopy and energy dispersive X-ray analysis. The effect of various parameters on the electrocatalytic oxidation of ethanol were investigated and optimized. The electrooxidation of ethanol on the surface of the modified electrode was studied using cyclic voltammetry and chronoamperometry techniques. The results obtained in this study, indicate that the proposed catalyst possess a high electrocatalytic activity for ethanol electrooxidation.

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Electrochemical oxidation of Methylene Blue using two different types of graphite electrode

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Anodic oxidation is an effective direct electrochemical advanced oxidation process where adsorbed hydroxyl radicals (M (HO$^\cdot$)) are produced at the anode surface (M) by reaction[1]. At the cathode surface, electro generation of $H_2O_2$is occurred through electron reduction of injected O_2[3]. The aim of this work is two evaluate the electro chemical oxidation of Methylene Blue (MB) for aqueous solution treatment by two different graphite electrodes. In this study, two different graphite electrodes were used in which the first type (A) was more compacted than the second type (B). MB decolourization was performed in batch system under reaction conditions as follow: $[Na_2SO_4]$ =0.05 M, V=50 ml, C_0=10 ppm, I=100 mA. The percentage of color removal or decolourization efficiency was calculated by Eq. (1).

$$\text{color removal}(\%) = \frac{A_0 - A_t}{A_0} \times 100 (1)$$

where A_0 and A_t are the concentration at initial and final solution(λ_{max}=664nm), respectively. The results showed that the type of electrode had significant effect on the color removal. As can be seen in Fig. 1, the solution was absolutely transparent after treatment using electrode A compared with the solution treated over electrode B. Fig. 2 shows the trend of color removal over the experiment time. The electrode A had the highest efficiency (99%) after 40 min while the highest efficiency of electrode B was lower than 70%. In fact, the compact nature of electrode A enhanced the radical generation as well as decolorization process.

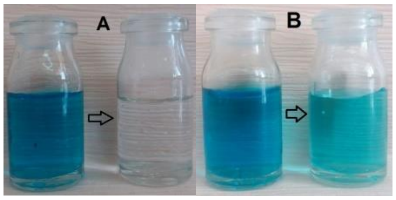

Fig.1. Effect of type (A) and (B) electrode.

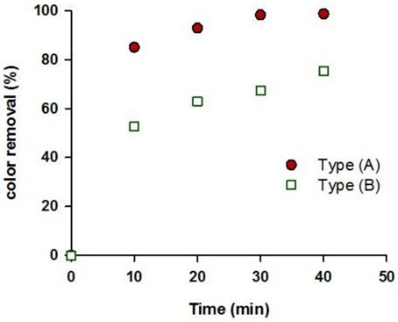

Fig.2. MB color removal using two different graphite electrodes.

The oxidation of MB for aqueous solution treatment has been investigated using two different graphite electrodes. The results showed that the more compacted electrode had a higher oxidation power. The highest color removal efficiency was 99% after 40 min.

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Electrochemical oxidation of 2,3-dihydroxypyridine in the presence of arylsulfonic acid

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Among pyridine derivatives, hydroxypyridines have attracted scientific interest in areas such as pesticide design [1]. clinical therapeutics and pharmacology [2,3]. In this work, we study Electrochemical behavior of 2,3-dihydroxy pyridine in the various pHs using cyclic voltammetry to investigate the acidic dissociation constant. Some new unsymmetrical diaryl sulfones were synthesized by anodic oxidation of 2,3-dihydroxy pyridine in aqueous solutions in the presence of arylsulfonic acids at a carbon electrode. The data show that the electro generated pyridine-2,3- dione was converted to the unsymmetrical diaryl sulfones by Michael type addition reaction with ECE mechanism. This work has led to the development of a high yield, green, reagentless and facile electrochemical method for the synthesis of the described sulfones.

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Pt nanoparticles supported on functionalized carbon nanoparticle and reduced graphene oxide nanosheets for electrooxidation formic acid

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Direct formic acid fuel cells (DFAFCs) have attracted great attention as a new generation of power sources with high operating power densities and low emissions [1]. platinum has known as the primary part of catalysts in low-temperature fuel cells due to its fast kinetics of oxidation-reduction reactions. But due to problems such as high costs and the finite resources of platinum and low tolerance against poisoning, it is difficult to commercialize it. Therefore, the use of various forms of pure platinum, such as platinum nanostructures or platinum-based carbon nanocomposites or the addition of the metal or metal oxide, is essential in order to reduce expenses and increment their electrocatalytic attributes and to withstand further poisoning for alcohols oxidation in fuel cell which in recent years, there has been great effort in this regard. A wide range of studies have been carried out on supported catalysts for formic acid oxidation in recent decades, which including carbon materials with various shapes and forms such as carbon nanotubes (MWCNT) [2] graphene [3], carbon nanohorns [4] and etc.In this study, for the first time to our knowledge, we have systematically investigated the effects of tosyl-CNPs (tosyl groups functionalized carbon nanoparticles) and rGO (reduced grapheneoxide nanosheets) as catalyst support on the electrocatalytic activity of Pt nanoparticles for formic acid oxidation used in fuel cell applications and compared together.The physicochemical features of the series of the PtNPs, PtNPs/tosyl-CNPs and PtNPs/rGO modified carbon-ceramic electrode is characterized with different methods including X-ray diffraction (XRD), energy dispersive X-ray spectroscopy (EDX), field emission scanning electron microscopy (FE-SEM)and the electrocatalytic activity of electrodes modified with PtNPs and Pt/tosyl-CNPs for formic acid electrooxidation are comprehensively discussed with cyclic voltammetry and chronoamperometry. The obtained results show that the PtNPs on the functionalized carbon nanoparticles present high electrocatalytic activity over than the reduced grapheneoxide nanosheets support. Therefore, the PtNPs/tosyl-CNP/CCE can be extended as a promising electrocatalyst for the formic acid electrooxidation reactions in fuel cells.

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Assessment of a submerged membrane electro-bioreactor (SMEBR) for wastewater treatment and reduction of membrane fouling

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Recently, membrane bioreactors have been widely used for municipal and industrial wastewater treatments [1-4]. In these systems concentration of the extracellular polymeric substance (EPS) and soluble microbial product (SMP) are of the main factors in membrane fouling, where the impact of the electrochemical processes on them is not completely investigated. In this study, for further improving the effluent quality and reduction of membrane fouling in conventional submerged membrane bioreactor (SMBR), were used from submerged membrane electro-bioreactor (SMEBR). For effecting of electrochemical process on the membrane fouling, we applied two MBR systems (with/without electrochemical cell). Aluminum with a submerged area of 50 cm^2 (Length of 10 cm and wide of 5 cm) was used as sacrificial anode and also other aluminum blade of same size was used as cathode. The electrode distance of 3.5 cm was maintained between anode and cathode during electrolysis that cathode located at near the membrane. A direct current was supplied by a DC-regulated power source. The chemical oxygen demand (COD) removal, transmembrane pressure (TMP), sludge specification such as soluble microbial product (SMP) and extracellular polymeric substance (EPS), in both bioreactors were determined for treating wastewater. The results indicated COD removal did not show significant difference in both bioreactors. However, SMEBR had better function in reducing the membrane fouling and decreased transmembrane pressure (TMP) by 50% compared to SMBR. Also, in SMEBR decreased total EPS and SMP (about 30-50%) compared to SMBR. In addition, with applying of electrical field in SMBR, the structure and morphology of mixed liquor suspended solid was changed. Also, the amount of sludge production in the SMEBR system was reduced by about 70% compared to the SMBR.

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One-step two-electrode electrodeposition of intercalated layered double hydroxide for effective uptake of heavy metal ions

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In this work, intercalated Cu Cr-layered double hydroxide nanosheet (DS-LDH) has been successfully fabricated on a carbon cloth substrate via a facile two-electrode electrodeposition method. The one-step two-electrode electrodeposition method showed good repeatability in the coating on the flexible substrate. Electrodeposition technique has emerged as a competitive technique for the coating of LDH on surfaces for advantages such as ease of control, high speed, simplicity, low cost, one-step method, and the possibility of making a large-area surface. The electrodeposition method allows the deposition of well adherent, homogeneous and single phase LDH coatings on electrodes [1-4]. The resulting DS-LDHwas characterized by X–ray diffraction (XRD), Fourier transformed infrared (FTIR) spectroscopy, scanning electron microscopy (SEM), transmission electron microscopy (TEM), and Energy-dispersive X-ray (EDX) technique. The DS-LDH coated on the carbon cloth was used for the effective uptake of heavy metals and exhibits superior selectivity as well as a higher adsorption capacity for Hg(II) ions even in the presence of high concentration levels of competitive ions. The Sorption isotherm for Hg(II) agrees with the Langmuir model and thus suggests a monolayer adsorption. The DS-LDH coated on the carbon cloth exhibits a high record saturation Hg(II) uptake capacity of over 2500 mg g^{-1} and distribution coefficients of 4.10×10^6 mL g^{-1}, which place it at the top of materials known for the uptake of Hg(II). The sorption kinetics for Hg(II) follows a pseudo-second-order model, suggesting a chemisorption binding. Moreover, we observed efficient Hg(II) removal from tap water, well water, river water, and seawater samples. The excellent efficiency in recycling studies and good stability of the coating are other properties of the adsorbent.

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A new Polypyridyl Osmium (II) complex as an efficient electrocatalyst for CO_2 reduction

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The greenhouse effect and the global warming are serious problems because the increasing global demand for the fossil fuels has led to a rapid rise in greenhouse gas exhaust emissions in the atmosphere. Therefore, the development of sustainable renewable energy resources is highly demanding to provide energy and control the global warming.[1]Several techniques have been utilized for the CO_2 reduction such as carbon capturing and storage, radiochemical method, chemical reduction, thermo-chemical reduction, photo-chemical reduction, electrochemically reduction, biochemically reduction, bio-electrochemical conversion, and enzymatic electrosynthesis.[2,3] Among the various methods for utilization of CO_2 as C_1-building block, the efficient and selective electrochemical reduction appears to be important and promising.[4] However, the electrochemical CO_2 reduction proceeds only at high cathodic overpotentials due to the initial reduction of CO_2 molecule into the surface-adsorbed $CO_2^{-\cdot}$ radical. Therefore, it is still a subject of intensive studies after decades of research. [5] One method to overcome this problem is to use the transition metal complexes as the homogeneous catalysts, because they require relatively mild conditions and lower over-potentials than the direct reduction of CO_2 at bulk metal electrodes. [4,5] Herein, we report the synthesis and characterization of a new polypyridyl osmium (II) complex by elemental analysis and spectroscopic methods. Further, the electrocatalytic activity of this complex was investigated for CO_2 reduction to CO in an acetonitrile solution using cyclic voltammetry under different reaction conditions including electrocatalystconcentration, CO_2 purging time, temperature, and scan rate. The mechanism of electrochemical CO_2 reduction to CO was also studied by DFT calculations.

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Evaluating the photoelectrocatalytic activity of camphor sulfonic acid doped polyaniline-WO_3-reduced graphene oxide ternary nanocomposite in solar induced water splitting

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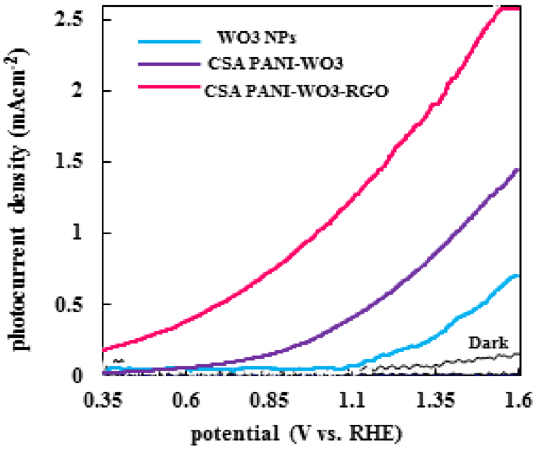
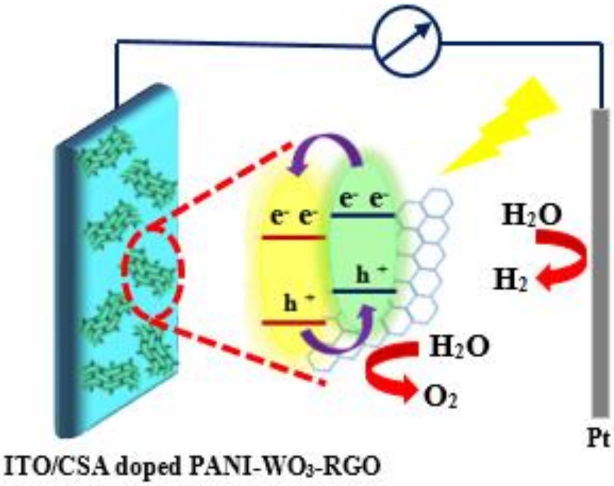
Nowadays, production of hydrogen and oxygen gases via photoelectrochemical water splitting (PEC) process using renewable and clean solar light is considered lots of attention [1,2]. Nanocomposites of metal oxide semiconductors with conductive polymers and carbon-based materials were used for fabrication of photoanode [3]. In this project, the camphor sulfonic acid doped polyaniline-WO_3-reduced graphene oxide (CSA PANI-WO_3-RGO) ternary nanocomposite was synthesized and used as photoanode for oxygen evolution reaction (OER) in solar water splitting. The linear sweep voltammetry (LSV), electrochemical impedance spectroscopy (EIS) and Mott Schottky (M-S) tests were done for investigating the photoelectrochemical performance of as-prepared composite. The pure WO_3 and camphor sulfonic acid doped polyaniline-WO_3 (CSA PANI-WO_3) binary nanocomposite were used for comparison. All tests were carried out in 0.1 M Na_2SO_4 in dark and under illumination of Xenon lamp. The photocurrent density of CSA PANI-WO_3-RGO (1.54 $mAcm^{-2}$) is 2.41 and 8.11 times higher than that of WO_3(0.19 $mAcm^{-2}$) and CSA PANI-WO_3 (0.64 $mAcm^{-2}$). Also, the charge transfer resistance of CSA PANI-WO_3-RGO was lower than binary composite and pure WO_3 nanoparticles indicating the enhancement of photoelectrocatalytic efficiency due to the effective interfacial separation of electron and holes in the presence of RGO.





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Electrochemical oxidation of Mefenamic acid in the presence of nitriteion as a nucleophile

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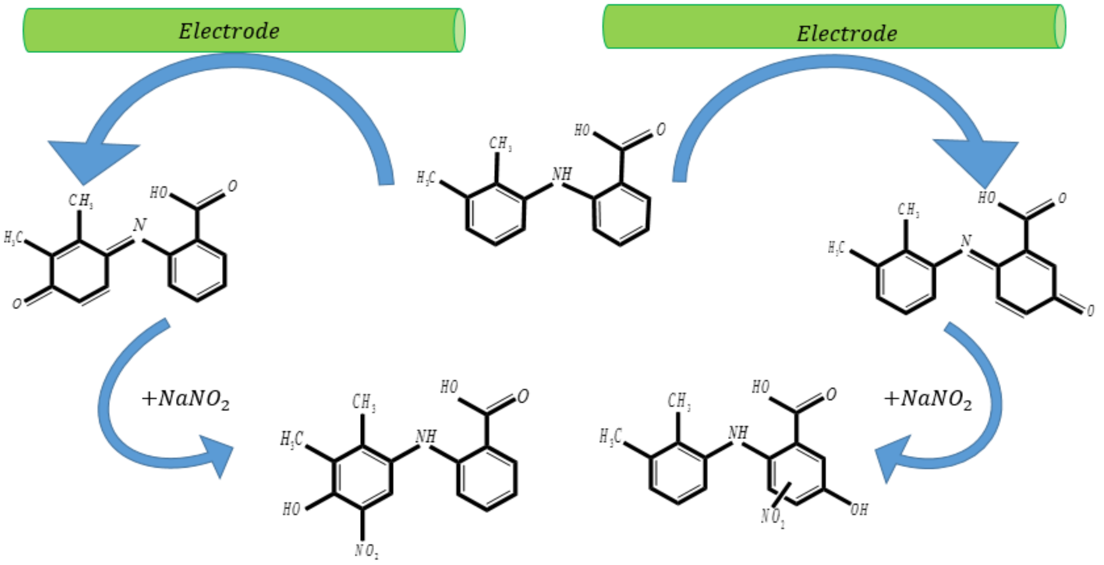
Mefenamic acid (2-[(2,3-dimethylphenyl) amino] is an importantnon-esteroideal anti-inflammatory drug used to treat several pathologies [1]. It is used in cases of mild to moderate pain, including a headache, dental pain, post-operative and post-partumpain, anddysmenorrhoeae, in musculoskeletal and joint disorders such as osteoarthritis [2]. The anti-inflammatory effect of MFA is due to the inhibition n of the production of prostaglandins formed by cyclooxygenase (COX) enzymes. Mefenamic acid (MFA) has been associatedwith rare but severe cases of hepatotoxicity, nephrotoxicity, gastrointestinal toxicity, and hypersensitivityreactions that arebelieved to result from theformation of reactive metabolite [3]. In the case of overdose mefenamic acid in the body, it is oxidized by the P450 enzyme and the resulting oxidation product in the body can cause many complications for humans. Due to the procedure similarity of the electrochemical oxidation of mefenamic acid with its biological oxidation in the body, in this work, the electrochemical oxidation of mefenamic acid under different conditions will be investigated and it is expected that we can obtain the pK_a belong to this drug by the electrochemical method by means of collected information. Then, the possible products of mefenamic acid oxidation will be synthesized alone and in the presence of nitriteion and will be identified by the IR and NMR spectra.



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Electrocatalytic activity of Ag@Pt core-shell nanoparticles supported on graphene for effective anodic fuels electro-oxidation

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Recently,fuel cells as promising efficient energy sources for portable, stationary power generation and power for transportation have received significant attention.Direct fuel cells such as direct methanol fuel cells (DMFCs), direct ethanol fuel cells (DEFCs) and direct formic acid fuel cells (DFAFCs) as green energy sources have attracted great attention due to unique properties such as high energy density, low operating temperature, environmental compatibility, fast recharging and relatively simple instruments [1-3]. In this work, Bimetallic Ag@Pt core-shell nanoparticles supported on graphene nanosheets (Ag@Pt-GRs) was successfully synthesized by a facile stepwise method and used as novel desirable platform for effective catalytic electro-oxidation of ethanol, methanol in alkaline media and formic acid. The morphology and electrochemical properties of Ag@Pt-GRs nanocomposite were characterized by transmission electron microscopy, X-ray diffraction, chronoamperometry and cyclic voltammetry. Based on experimental results, Ag@Pt-GRs nanocomposite exhibits attractive electrocatalytic activity for the oxidation of formic acid, methanol and ethanol due to synergistic effect of Pt, Ag and graphene nanosheets. Ag@Pt-GRs nanocomposite possesses higher electrocatalytic activities in comparison to the Pt-GRs nanocomposite, which may be attributed to enhancing the usage of Pt due to the formation of core-shell structure. The proposed nanocomposite with good stability and high catalytic activity can be a promising catalyst for fuel cell application.

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Fabrication and Study of GO/ ɣMnO_2Nanocomposite forSupercapacitors

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Supercapacitors are electrical storage devices that can deliver a high amount of energy in a short time. Supercapacitors provide higher energy and power density than conventional capacitors batteries respectively [1]. In this work, to improve the capacitance of supercapacitor, we modified the working electrode. The first, graphene oxide (GO) was synthesized from graphite using Hummers method [2] and γMnO_2 nanoparticles were synthesized using solid state reaction. Then GO-γMnO_2nanocomposite with a weight ratio of 4:1 and 2:1were prepared by the reflux method. The phase structure of samples was studied using X-ray diffraction (XRD). The XRD patterns revealed characteristic peaks of γMnO_2 and GO powder. The morphologies of samples were examined with scanning electron microscopy (SEM). SEM image showed nanoparticles and nanorods attributed to γMnO_2nanostructure that these are supported on the graphene sheet. The working electrode was prepared on stainless steel (SS) meshes with deposition of GO, γMnO_2 and GO-γMnO_2 (4:1 and 2:1) on SS meshes. The electrochemical properties of samples were investigated by cyclic voltammetry (CV), galvanostatic charge/discharge (GCD) in 1.0 M Na_2SO_4 aqueous solution. The capacitances of the electrodes were calculated from the recorded CV and GCD curves.

The results exhibited the best discharge capacitance and cycle performance for a sample containing GO-γMnO_2than the pure sample with GO and γMnO_2. Moreover, this sample may provide an excellent candidate material to use in supercapacitors because of its large specific capacitance and long-term stability.

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Cerium Molybdate nanoparticles anchored on N,P dual doped- Reduced Graphene Oxide as a High Performance Supercapacitor

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In today's world, electrochemical supercapacitors (ESs) could be considered as one of the most important energy storage devices for a larger number of power portable electronics and electric vehicles. They can be classified into two major groups based on the charge-storage mechanisms in them, electrical double-layer capacitors and pseudocapacitors [1]. The pseudocapacitors could have an individual capacitance due to their electrochemically active materials through a rapid and faradic redox reaction. Numerous materials are used in the construction of them, such as transition metal oxides, and conductive polymers. Indeed, these materials have shown a higher capacity than those carbon-based materials [2]. However, the high internal resistance and lower the cyclic stability of metal oxides could be the main reason for the limitation in their use in commercial ESs. There are many attempts to solve this problem, such as the application of the metal oxides with carbon-based materials as nanocomposite, for examples; exfoliated graphite, mesoporous carbon, carbon black, carbon nanotubes, and graphene oxide [3]. In the present study, a simple method for preparation of nanostructured cerium molybdate ($Ce(MoO_4)_2$)/N,P dual doped- reduced graphene oxide (NPRGO) as the ES electrodes is introduced using ultrasonic vibration. Applying ultrasonic waves is a simple method for the synthesis of nanostructures. The pseudocapacitive behaviors of the $Ce(MoO_4)_2$, $Ce(MoO_4)_2$/RGO, and $Ce(MoO_4)_2$/NPRGO composite electrodes were examined by cyclic voltammetry (CV), galvanostatic charge/discharge, and electrochemical impedance spectroscopy in a 0.5 M Na_2SO_4 electrolyte. These results show the calculated specific capacitance values for the $Ce(MoO_4)_2$, $Ce(MoO_4)_2$/RGO, and $Ce(MoO_4)_2$/NPRGO electrodes are equal 327, 488 and 638 F g^{-1} at scan rate 5 mV s-1, respectively. In order to gain further understanding about the supercapacitive performance, the galvanostatic charge/discharge of the $Ce(MoO_4)_2$, $Ce(MoO_4)_2$/RGO, and $Ce(MoO_4)_2$/NPRGO electrodes are measured at the potential range of 0.0 to1.0 V at the different charge/discharge current density. The composition of RGO and NPRGO with $Ce(MoO_4)_2$ nanoparticles improved the conductivity of nanocomposites by reducing the ionic mass-transfer resistance [4]. Consequently, it leads to enhancement in the power as well as the energy density of the nanocomposite electrodes. Electrochemical evaluations also showed that the $Ce(MoO_4)_2$/NRGO electrode has higher SC, stability, and energy density than pure $Ce(MoO_4)_2$ and $Ce(MoO_4)_2$/RGO electrodes. The stability of electrodes under lager number of potential cycling was studied by the continuous cyclic voltammetry (CCV) technique at high scan rate (200 mV s^{-1}). The CCV test exhibited that the SC of the $Ce(MoO_4)_2$/NRGO electrode retained approximately 97.9% of its initial value after 4000 potential cycling. The EIS and galvanostatic charge/discharge studies confirm the obtained results of CV and CCV measurements. Based on these results, it could be suggested that the $Ce(MoO_4)_2$/NPRGO nanocomposites is a promising material to improve the performance of SC electrodes. Furthermore, we hope to extend the present synthetic strategy to other metal molybdates and carbon material such as CNTs and mesoporous carbons in order to facilitate large-scale production of nanocomposite materials for supercapacitor technology.

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Action of *Lallemantia royleana* seed gumon the corrosion of carbon steel in acidic media

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Carbon steel usually used for materials engineering including mining, metal-processing equipment, marine applications, transportation, nuclear plants, pipelinesand chemical processing construction [1].In procedures such as acid pickling processes, oil well acidizing, industrial acid improvement and acid descaling, carbon steel generally damaged due to exposure to strong acids particularly HCl solutions [2]. Using of corrosion inhibitors is one of the simplest and economical method to resolve corrosion problems [3].Due to toxicity and synthesis limitations of some materials which used as corrosion inhibitors, eco-friendly materials are interested [4].The aim of the present work is to investigate the effect of *Lallemantia royleana* seed gumon the acid corrosion of carbon steel in HCl solution using weight loss, AC impedance and potentiodynamic polarization methodes.The effect of temperature on the corrosion inhibition effect of *Lallemantia royleana* seed gumwas also studied by using weight loss and potentiodynamic polarization methods. The obtained results demonstrate that inhibition efficiency in both methods increased with increasing concentration of the extract while inhibition efficiency decreases with increasing temperature. Potentiodynamic polarization curves revealed that *of Lallemantia royleana* seed gumbehaves as mixed-type inhibitor. At all temperatures, the adsorption of the extract components onto the steel surface was found to follow Langmuir adsorption isotherm. The morphology of the corroding steel surface in the absence and presence of *Lallemantia royleana* seed gumwas visualized using scanning electron microscopy (SEM).

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Comparison of cellulose acetate and Polyvinyl alcohol polymers in synthesizing of the zirconium silicate nanofibers

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In this research, zirconium silicate nanofibers were synthesized by use of an electrospinning machine. Two different polymeric solutions were used separately for fabrication of the nanofibers. First, the aqueous solution of polyvinyl alcohol and the solution of cellulose acetate in acetic acid and acetone were prepared respectively [1-5]. After that zirconium silicate was added to both solutions in a same aspect ratio. The obtained solutions were electrospun under 30 kV and then calcinated in 550oC for 3 hours. The FTIR spectra of samples showed the omission of C-H, O-H and C-H functional groups after calcination process. The X-ray diffraction patterns in both solutions showed the formation of tetragonal crystal structures in both samples. The SEM images of samples revealed that the average diameter of nanofibers in the first sample is 102 nm and in the second sample is 80 nm in the same conditions of fabrication.

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Electrochemical synthesis and comparative investigation of reactivity of three mono aza crown ethers with different size of crown towards Michael addition reaction

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Catechols and their quinone derivatives are abundant in nature and play important roles in many biological systems. The metabolisms of catechols and hydroquinones often involve their oxidation to the corresponding quinones and subsequent nucleophilic addition reactions with compounds containing electron-donor atoms such as thiols [1, 2] and amines [3, 4]. In this study, the electrochemical oxidation of catechol (1) has been studied in the presence of three nucleophiles with different size of crown including mono aza-15-crown-5 (A15C5) (3a), mono aza-18-crown-6 (A18C6) (3b), and mono aza-12-crown-4 (A12C4) (3c) in aqueous solution, by means of cyclic voltammetry and controlled-potential coulometry. The results revealed that the quinone derived from the oxidation of catechol participates in Michael addition reactions with mono aza crown ethers (3) and via an ECE mechanism, converts them to the o-benzoquinone-aza crown ether adducts (5). These products were derived based on electrochemical oxidation under controlled potential conditions in aqueous solutions at a carbon electrode in a two-compartment cell. In addition, for the first time, reactivity of the mono aza crown ethers with different size of crown towards 1,4-(Michael) addition reaction was compared to each other. The results show that for mono aza crown ethers with decreasing of size, reactivity towards o-benzoquinone is increased.

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Electrochemical determination of propranolol, using modified carbon paste electrode

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Propranolol is commercially employed in the form of hydrochloride and has also been suggested for use in a number of other conditions including dysfunctional labor and anxiety [1]. Several techniques for the analytical determination have been reported in the literature fordrugs determination which includes chromatography, capillary electrophoresis, spectrophotometry and conductometry. However, these techniques have the insufficiency of being expensive, laborious and require pre-treatment or multi-solvent extraction of samples. Electrochemical techniques have attracted considerable interest due to the good simplicity, sensitivity, selectivity, stability and often do not require any pre-treatments or pre-separation. Modifier such as nanoparticles, polymers, carbon ionic liquid, carbon-ceramic and carbon nanotubes could enhance the transfer rate of the electron and reduce the over-potential for the oxidation of substrates [2].Choosing the most convenient modifier for each analyteUsing chemically modified electrodes (CMEs) have some benefits such as decrease of the potential required for the electrochemical reaction to occur and enhance is very important in CMEs utilization in speciation work, due to effect of modifier characteristics on the sensitivity and selectivity of the electroanalytical response. Carbon paste electrodes (CPEs) are widely used for the electrochemical determinations of a various biological and pharmaceutical species due to their low residual current and noise, ease of fabrication, wide anodic and cathodic potential ranges, rapid surface renewal, and low cost [3]. Carbon paste electrode was modified with magnetic modified chitosan (Fe_3O_4/Al_2O_3/Chitosan) and square wave voltammetry was applied as the detection technique after open-circuit sorption of propranolol. Optimized conditionswere (amount of modifier 10% and time of exposure electrode 10 min and pH=7). The figures of merit of proposed sensor and the other sensors were reported in table. As shown in the table, the response of proposed sensor under the optimized conditions was acceptable. The sensor was successfully applied to the trace determination of propranolol in spiked samples.

Electrode	Conc. Range	LOQ	LOD	Reference
ZrO2/SPE	10.0 to 200.0 µM	10.0 µM	1.5 µM	[1]
Nitrogen-Containing Tetrahedral Amorphous Carbon	0.9 to 9.8 µM	0.9 µM	0.75 µM	[4]
Nano ITIES	2.0 to 10 µM	2.0 µM	0.8 µM	[5]
Proposed sensor	1 to 6 µM and 14 to 284 µM	1 µM	0.3 µM	This work

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High-specific sensing of miRNA-541 based on sequence-specific digestion by restriction enzymes

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A genosensor for miRNA-541 detection based on an enzymatic digestion method using restriction enzymes (REs) is introduced in this article. REs can cut double helix DNA at a specific sequence. The hybridization event and enzymatic reaction are studied through guanine signal tracing on the graphene quantum dots modified pencil graphite electrode (GQD/PGE) [1]. The stages of fabricating the electrode were monitored by atomic force microscopy as well as their electrochemical behaviors were studied by cyclic voltammetry. The results indicate that the guanine signal of an immobilized 25-mer oligonucleotide of 7-guanine on the electrode surface decreased after hybridization. After enzyme treatment, the current decreased further due to separation of number of guanine base from ds-DNA. The comparison of analytical parameters of the proposed detection method with the conventional guanine oxidation method [2,3] indicates that REs increases the sensitivity of the genosensor to measure the analyte to femto-level. The selectivity of the designed biosensor was proved using non-complementary sequence with one- base mismatch in the recognition site instead of complementary sequences. Using differential pulse voltammetry, a wide range from 1.0 fM to 1.0 nM and a detection limit of 0.9 fM were obtained for determination of microRNA-541 under optimized experimental conditions.

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Manufacture of electrochemical sensors for measuring Acetylcholine with the help of Three Dimensional NiO Nanowrinkles

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The action of acetylcholine (ACh) as a neurotransmitter was first confirmed by Loewi's demonstration that stimulation of the vagus nerve released a substance that decreased beating rate when applied to an isolated heart. Muscarinic acetylcholine receptors are present in neurons in the central and peripheral nervous systems, cardiac and smooth muscles, and a variety of exocrine glands[1]. Electrochemical sensors have attracted considerable interest of analysts due to advantages such as rapid sample-to-answer time, high sensitivity, low cost and potential translation in point-of-care settings. But as is well-known, the classic electrochemical sensor only comprises a single response signal, which suffers from low reproducibility due to numerous factors including variations in base electrode properties (i.e., area, morphology), probe loading densities, etc. aswell as complex detection environments [2]. Among transition metal oxide, Nickel oxide (NiO) have shown good electrochemical performance and also have gained considerable attention in past few years due to its mechanical, electronic and optical properties and have been used as smart windows, supercapacitor, electrode, catalyst and electrochromic device [3]. Considering the above, a sensitively selective electrochemical sensor based on three-dimensional nickel oxide nanowrinkles has been successfully developed to detect acetylcholine. The diffusion coefficient, and the kinetic parameter such as the electron transfer coefficient of acetylcholine oxidation at the surface modified electrode was determined using electrochemical approaches. It has been found that under an optimum condition (pH 7.0), the oxidation of acetylcholine at the surface of such an electrode occurs at a potential about 250 mV less positive than that of an unmodified electrode. Under optimum conditions, modified electrode exhibited linear dynamic rang frem 0.3 to 600.0µM with detection limit of 0.01µM.

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Label-free electrochemical aptasensor based on catalytic activity of molybdenum disulphide−graphene nanocomposite for detection of TNF−α

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Tumor necrosis factor-alpha antigen (TNF-α) is a kind of important protein biomarkers, which have been correlated to many infectious and inflammatory diseases such as rheumatoid arthritis, diabetes, stroke, HIV infection, neonatal listeriosis, systemic erythema nodosum leprosum, endotoxic shock, severe meningococcemia and graft rejection [1,2]. Since the concentration of biomarkers in human fluids such as in blood, urine, and other tissues is very low; sensitive detection of biomarkers such as TNF-α is very importance because it helps to early diagnosis of diseases, and also provides the possibility of better treatment of diseases [3]. In this work, a practical and novel enzyme-free sandwich-type electrochemical aptasensor for sensitive detection of protein biomarker tumor necrosis factor-alpha (TNF-α) was designed by using molybdenum disulfide functionalized graphene nanosheets as novel desirable labels for signal amplification as sensing platform. The results showed that proposed nanocomposite exhibited attractive electrocatalytic activity without any enzyme towards the oxidation of hydroquinone as an analytical signal and also yielded a large surface area, which improves the amount of immobilized TNF-α aptamer. The aptasensor was constructed by modifying screen-printed electrodes with nanocomposite. Under optimal conditions, the proposed electrochemical aptasensor showed a dynamic range from 2.0 pg/mL to 80 pg/mL with a low detection limit of 0.7 pg/mL for TNF-α. The interassay RSD was 4.25% by detecting 10.0 pg/mL TNF-α with five aptasensors, which results suggested that the proposed aptasensor had good reproducibility. To assess the specificity of the proposed aptasensor to TNF-α, we further chose three proteins including BSA, CEA, CA15-3 and two common small molecules (DA, AA) with 20-fold concentration over 10.0 pg/mL TNF-α. Based on obtained results, there were no obvious changes in the response current in the presence of several interferences, indicating that the developed method possesses good detection selectivity.The analytical usefulness of the aptasensor was finally demonstrated analyzing serum samples. The main advantages of this aptasensor are the simple fabrication method, high sensitivity, specificity, good reproducibility and stability as well as acceptable accuracy for TNF-α detection in human serum samples, which might have broad applications in protein detection and disease diagnosis.

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Construction of biocompatible molecular imprinting polymer based on chitosan and used of MWCNTs as a platform for electrochemical sensing of norepinephrine

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Norepinephrine is one of the catecholamine neurotransmitters which is released from the nerve ending in the sympathetic nervous system [1, 2]. Some disease such as stress, a fall in blood pressure and depression can be related to abnormal level concentration of norepinephrine [3]. Then fabrication of suitable device to determine of norepinephrine is important. In this work electrochemical sensor coupled with molecular imprinted polymer (MIP) was constructed. The use of MWCNTs as a support material enlarges the sensing area on the glassy carbon electrode, while the MIP film from chitosan as a biocompatible and natural polymer warrants improved selectivity for epinephrine. Quantification of the template on the MWCNTs@chitosan film was performed by employing hexacyanoferrate as the electrochemical probe. Scanning electron microscopy, cyclic voltammetry and electrochemical impedance spectroscopy were applied to characterize the sensor materials. Influencing factor such as the percent of MWCNTs, the electropolymerization time, and the elution condition were optimized. The design sensor shows linear range from 5×10^{-8}M to 1×10^{-6} M for detection of norepinephrine by differential pulse voltammetry. The detection of norepinephrine in serum sample by using chitosan (MIPs)/MWCNTs sensor also gave satisfactory results.

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Sensitive electrochemical detection of dopamine with CuO nanoflowersmodified glassy carbon electrode

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Electrochemical techniques are among the most appealing choices for biological and pharmaceutical compounds. Electrochemistry often offers analytical techniques which are characterized by instrumental simplicity, moderate cost, high sensitivity, portability and some other unique advantages. Due to similarity-y between redox reactions that taking place in electrochemical and biological systems, it can be assumed that oxidation-reduction reactions occurring in the body and at the surface of electrodes share similar principles [1]. Dopamine (DA) is a hormone and neurotransmitter of the catecholamine and phenethylamine families produced within the adrenal glands and several areas of the brain that plays a number ofimportant roles in the human brain and body [2]. Abundance and deficiency of this vital chemical is the foremost reason of several important neurological disorders in the human body such as Parkinson's disease, restless leg syndrome, attention deficit hyperactivity disorder, schizophrenia, and the HIV infection [3]. In this study, a glassycarbon electrode (GCE) modified withCuO nanoflowers, was used to prepare a novel electrochemicalsensor for the detection of dopamine. Under the optimum pH, it has been found that the oxidation of dopamine at the surface of modified electrode occurs at a potential of about 180 mV less positive than that of an unmodifiedglassycarbonelectrode. DifferentialPuls voltammetry exhibited linear dynamic rangefrom 5×10^{-7} to 8×10^{-5} M and detection limits of7.3×10^{-8} M for dopamine. The present method was applied to the determination of dopamine in some real samples.

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Simultaneous determination of N-acetylcysteine and folic acid in the presence of unknown interference using a nanostructured modified sensor: application of chemometric approaches in the electrochemical studies

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N-acetylcysteine (N-AC) is a precursor in the formation of L -cysteine and the antioxidant glutathione in the body. It isa mucolytic agent used to reduce the viscosity of pulmonary secretions in respiratory disorders. [1]. It is also used as an antidote to paracetamol poisoning [1–3]. Another material which was investigated in the present study was folic acid (FA). FA is a water-soluble vitamin. It acts as a coenzyme in the regeneration of methionine from homocysteine. FA deficiency is a common cause of anemia and it is thought to increase the likelihood of heart attack and stroke [4]. In this work, a voltammetric method coupled with multivariate curve resolution-alternating least squares (MCR-ALS) was applied for the simultaneous determination of NAC and FA in the blood serum samples containing unknown interferences. Thus, a carbon paste electrode modified with bis (N-2-bromophenyl-salicydenaminato) nickel (II) and reduced graphene oxide (RGO) (Ni (II)/RGO/CPE) was used as an efficient electrochemical sensor. The modified electrode was characterized using different techniques such as scanning electron microscopy (SEM), and cyclic voltammetry methods. For the quantitative determination of NAC and FA with a high degree of overlapping electrochemical signal using the fabricated electrode, second-order voltammetric data was developed by changing the pulse height.The results obtained from MCR-ALS indicated that the linear ranges was 5.5-125.2 μM for NAC and 8.0-143.0 μM for FA and the detection limits were 3.37 and 4.43 μM, respectively.Also, after analyzing of the data using MCR-ALS, satisfactory recoveries for NAC and FA were obtained between 95.8-105.3% and 97.5-102.3%, for the blood serum sample, respectively. The designed method can be applied successfully for the simultaneous determination of NAC and FA in the complex systems with unknown interferences without the necessity of using separation technique.

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Modification of titanium anode electrode for ozone generation with metal oxides and nanocomposite

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Ozone as a powerful oxidation agentand the most important oxidant compoundis applied for disinfection in water treatment, decomposition of organic molecules, dyes, pollution, microorganism removing and etc. In addition, ozone is safer than many other oxidation agents because it decays to oxygen quickly and leaves no harmful residual. Many methodsare supposed for ozone production from air and pure oxygen such as ultra violet irradiation (UV) and cold corona discharge (CCD) but these methods cannot produce high ozone concentration in liquid phase. For achieving high dissolved ozone concentration, electrochemical ozone generation is used by electrolysis of water. Some electrodes such as titanium, BDD, tin, platinum, and lead are applied for ozone generation. The most important problem of electrochemical ozone production (EOP) from water is that water is oxidized to oxygen before ozone evolution because oxygen generation is thermodynamically favorable at lower anodic potential.

$$2H_2O \longrightarrow O_2+4H^++4e^- \qquad E^0=1.23\ \text{V vs RHE} \qquad \text{half-reaction 1}$$

$$3H_2O \longrightarrow O_3+6H^++6e^- \qquad E^0=1.56\ \text{V vs RHE} \qquad \text{half-reaction 2}$$

$$H_2O+O_2 \longrightarrow O_3+2H^++2e^- \qquad E^0=2.07\ \text{V vs RHE} \qquad \text{half-reaction 3}$$

In recently two-decades to fix this problem anode electrode is modifiedin order to shift oxygen generation potential (half-reaction1) to more positive potentials than ozone evolution reaction (half reaction 2,3). Ni-Sb-Doped SnO_2 materials (NATO) for modification of titanium anode has been repeatedly used but fabricated electrodesdid not have enough stability[1-5]. In this study water electrolysis potential was changed to potential of 1.97 V and ozoneproduction improvedwith adding CNT to NATO. In addition, stability of electrode was improved with adding TiHx interlayer between titanium substrate and NATO-CNT composite.

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Synergistic effect of TiO_2,$CeO_2$and GQD NanoparticlesonThe Photoelectrochemical Detection of Dopamine

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Due to basically role of dopamine (DA) in some diseases like Parkinson and Schizophrenia, its determination is important and thus, it is desirable to develop new, simple and rapid analytical methods for the determination of DA with high selectivity and sensitivity, especially for diagnostic applications [1-2]. Recently, developments in nanotechnology and preparations of semiconductor nanomaterials cause open a new field in photoelectrochemical methods based on nanosemiconductors for determination of DA [3]. In the present work, new nanocomposites with semiconducting property from TiO_2, $CeO_2$and Graphene quantum dot)GQD) nanoparticles are synthesized [4-5] and the photoelectrochemical responses of a modified glassy carbon electrode (GCE) with them, are evaluated by electrochemical method .s Photoelectrochemical measurements were performed using a P/G stat deviceand recorded by a conventional tree-electrod system (modified GCE, Ag/AgCl and Pt wire) that equipped with a 360 W halogen lamp (Visible wavelength range), in 0.1 M PBS solution and bias potential as 0.0 V.The modified electrodes showed outstanding response in the present of light in comparison to dark condition towards DA. Affecting parameters like pH, bias potential and DA concentration on photoelectrochemical responces of the modified electrodes were studied. Linear ranges, figure of merits and detection limits of the modified electrodes by the prepared semiconductors were calculated and compared with together. The best result was observed for a modified GCE with TiO_2/CeO_2/GQDin a wide linear range, 0.3-750 μM, with detection limit as 0.022 μM. Observed results will be presented and discussed here for the first time.

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Using of Hexagonal Ce^{3+}/NiO Nanoparticles and Modified Glassy Carbon Electrode for measurement of Amlodipine

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Amlodipine, (RS) 3-ethyl 5-methyl-2-[(2-amino ethoxymethyl]− 4 − (2 − chlorophenyl) − 1,4 −dihydro-6-methyl-3,5-pyridinedicarboxylate, is a potent calcium channel blocker used inthe treatment of angina and hypertension. “R” and “S” enantiomerdo not have the same biological activity. Only S-amlodipine dilatesthe blood vessels and improves the blood flow [1]. Carbon-based electrodes are a promising candidate. Carbon is chemically stable; provide good electrical conductivity. The carbon electrodes are easy to deposit using low temperature printing deposition processes such as screen printing, doctor-blading, inkjet-printing, rolling transfer, press transferring, and drop-casting [2].The suspension of micrometer or nanometer size nanoparticles in liquid، an ordinary way to enhance the heat transfer rate in a thermal system is to extend the surface area of cooling devices and a flow velocity or suspend the solid particles in working fluids.[3-4]In this present work, hexagonal Ce^{3+}/NiO nanoparticles were investigated to produce an improved electrode for measuring amlodipine in the presence of hydrochlorothiazide using cyclic voltammetric square wave voltmeter and chronoamprometry techniques.It has been found that under an optimum condition (pH 7.0), the oxidation of amlodipine at the surface of such an electrode occurs at a potential about 250 mV less positive than that of an unmodified electrode.Under optimum conditions, modified electrode exhibited linear dynamic range from 0.08 – 400.0 μm with detection limit of 0.02 μm.

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Functionalization of graphene by different ligands for biosensing

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Recently, many studies have been focused on the development of graphene-based biosensors. However, they rely on one type of signal and require to be calibrated by other techniques. In this study, a non-enzymatic graphene-based biosensor is designed and constructed and its ability to detect glucose and *Escherichia coli* by three different types of signals is investigated. For its preparation, dopamine-functionalized polyethylene glycol and 2,5-thiophenediylbisboronic acid are conjugated to the surface of graphene sheets by nitrene [2+1] cycloaddition and condensation reactions, respectively. Multivalent interactions between boronic acid segments and biosystems consequently increase the quantifiable fluorescence emission and UV absorption of dopamine segments. Additionally, changing the electrochemical behavior of the functionalized graphene sheets is possible and results in a measurable output signal [1-5]. Taking advantage of the versatility of the three different indicators including florescence, UV and electrochemistry, the functionalized graphene sheets have been used as self-regulating biosensors to detect variety of biosystems with a high accuracy and specificity in a short time.

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Atorvastatindetermination,using a novel electrochemical sensor

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Atorvastatin is a lipid-lowering agent and a member of a family of compounds referred to as statins [1] and is used to treat conditions such as pulmonary sarcoidosis. Voltammetric techniques are desirable techniques for the analysis of drugs because of their low cost, high sensitivity, ease of operation and portability [2]. As the most attractive derivative of voltametric techniques, deferential pulse voltammetry (DPV) has been applied to the determination of trace amounts of heavy metals and drugs [3].

On the other hand, carbon paste electrodes (CPEs) offer advantages of easy construction and surface-renewability, low costs, inertness, robustness, response stability, low Ohmic resistance, lack of an internal solution, and compatibility with various modifiers. Modification of CPEs can further enhance their surface properties and significantly enhance the target signals. The electrochemical experiments were performed using a Palm-Sens (EN 50,081–2) potentiostat, a PC for data acquisition and processing, and a three-electrode cell composed of the NF@Ch-modified carbon paste electrode (mCPE) as the working electrode, a saturated calomel reference electrode and a platinum auxiliary electrode (Azar Electrode Co, Iran). The potential readings were made against the reference electrode. After synthetized, the modifier was characterized, using FT-IR, TEM, VSM, XRD etc. To investigate the applicability of the mCPEs to the determination of ATV in real samples, human urine and plasma samples were used. Given that the samples were free from ATV, various amounts of the analyte were spiked to the samples prior to analyses. The effects of different organic/inorganic ions and compounds usually co-existing with ATV on the DPV analysis of this compound were studied investigated. Reproducibility and stability of NF@Ch-mCPEs were investigated through 9 successive analyses of a 50.0 nM ATV solution using one mCPE and the relative standard deviation (R.S.D.) was determined as 4.3%. The limit of detection of the method and the linear range were 35 pM and 0.1-100 nM respectively.

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Determination of L-tyrosine using NiO Nanoparticles decorated on graphene oxide Modified glassy carbon electrode

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L-tyrosine (Tyr) is a type of necessary amino acid that constitutes proteins. It is indispensable in human nutrition because it establishes and maintains a positive nitrogen balance [1-2]. L-tyrosine deficiency can cause albinism [3]. Therefore, it is important to detect exact concentration of L-tyrosine for human health. In the current research, a glassy carbon electrode (GCE) was modified with graphene oxide (GO) and NiO nanoparticles modified to obtain an electrode for determination of Tyr. The modified electrode exhibited good electrocatalytic properties toward the oxidation of Tyr. A synergistic effect involving both NiO and GO is invoked for explaining the observed electrocatalytic activity. Cyclic voltammetric and chronoamperometry methods were used to investigate the catalytic properties of the modified electrodes for Tyr electro oxidation in buffer solution. The anodic peak currents of Tyr were found to be linear in the concentration range of 5.0–100.0μM.

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Assessment of antioxidant activity and biosynthesis of silver nanoparticles by *Corn silk* aqueous extracts

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In recent years, there has been a great deal of attention toward the field of free radical chemistry. Free radical’s reactive oxygen species are generated by our body by various endogenous systems, exposure to different physiochemical conditions or pathological states. A balance between free radicals and antioxidants is necessary for proper physiological function. Many human diseases are caused or negatively affected by free radicals. The natural defence 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 against 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 [1-3]. Fruits, vegetables, grains, teas and some kinds of spices are natural sources of antioxidants. Medicinal plants used in the traditional medicine and healing are one of these sources of antioxidants. Corn silk (dried cut stigmata of maize female flowers, Zea mays L. ssp. mays, Poaceae) is a famous traditional herb drug. It is rich in phenolic compounds known to significantly affect human health, such as anthocyanins, *p*-coumaric acid, vanillic acid, protocatechuic acid, derivatives of hesperidin and quercetin, and bound hydroxycinnamic acid forms composed of *p*-coumaric and ferulic acid [4]. In this work, a simple and sensitive electrochemical method for the evaluation of antioxidant capacity has been developed. The electrochemical oxidation of leaf extract of *Corn silk* aqueous extracthas been investigated by cyclic voltammetry and Differential pulsevoltammetry (DPV) techniques. The results show that *Corn silk* aqueous extract oxidize at low potentials in comparison of gallic acid, salicylic acid and quercetin as standard antioxidants. The DPPH test (radical scavenging activity) was used for estimating antioxidant effect. Finally, the biosynthesis of silver nanoparticles has been performed by using *Corn silk* aqueous extracts. Phenolic compounds in *Corn silk* aqueous extracts reduces silver ions from silver nitrate to silver nanoparticles. Synthesized nanoparticles were confirmed by UV-Visible absorption spectrum of the reaction mixture.

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Decolourization of Methylene Blueusing heterogeneous electro Fenton process

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Electro Fenton (EF) process is a promising class of advanced oxidation processes (AOP_S) for waste water treatment owing to the continuous hydroxyl radical generation. Electrical current produces H_2O_2 at the electrode surface which decomposes into hydroxyl radical. The process is based on hydroxyl radical ($HO^{\cdot}$, $E^{\cdot}$=2.80V) chemistry which have been widely applied to degrade organic pollutants due to the nonselective oxidation property of $HO^{\cdot}$[1]. Decolorization of the organic dye in wastewaters has attracted more attentions due to their toxicity and re-fractory nature[2]. In this study Fe-loaded ZSM-5 zeolite (Fe-ZSM-5) was applied for the decolourization of Methylene Blue (MB) from aqueous solution through electro Fenton process. The effect of pH level of solution was stuied on the decolourization efficiency.

The ZSM-5 catalyst was prepared by hydrothermal method and Fe active phase (1%) was loaded through wet impregination process [3]. Charactrization of the synthesized catalyst was reported in literature [3]. MB decolourization was performed in batch system under reaction conditions as follow: [Na_2SO_4] =0.05 M, V=50 ml, C_0=10 ppm, I=100 mA, 10 mg of catalyst, and different pH of solution.It is accepted that pH level is an important parameter in electrofenton process. Fig. 1 represents effect of pH level on decolorization efficiceny of MB over Fe-ZSM-5 catalyst. As can be seen, the low level of pH (3) promoted the decolorization and increasing of pH decreased the efficiency. The high pH value led to the low rate of decolorization and the lower catalyst activity. This phenomenon can be explained by the leaching of iron from zeolite structure and formation of iron sludge. Ferrous ions precipitate at the neutral pH level in the form of iron sludge. Furthermore, this phenomenon can be explained by the scavenging effect of $OH^{\cdot}$ by H^{+}, the lower oxidation ability of $OH^{\cdot}$ and the unstable nature of H_2O_2 which decomposed to water and oxygen in higher pH levels. Therefore, the highest decolourization efficiency of MB (100%) was obtained at pH=3 after 60 min.

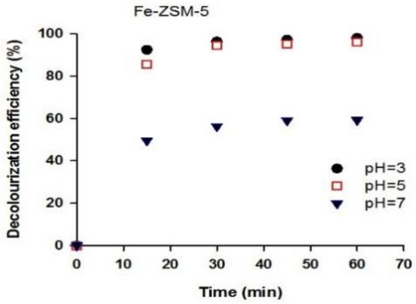

Fig.1. MB decolourization efficiency over Fe-ZSM-5 catalyst.

Fe-ZSM-5 was used in a heterogeneous EF process as catalyst for the decolourization of MB at different pH level of solution. The results showed that the low pH level favored the high decolourization eeficiency at heterogeneous EF process. The highest efficiency (100%) was obtained at pH=3.

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Numerical simulation of a flow electrochemical cell: effect of flow rate on deviation from ideal plug flow model

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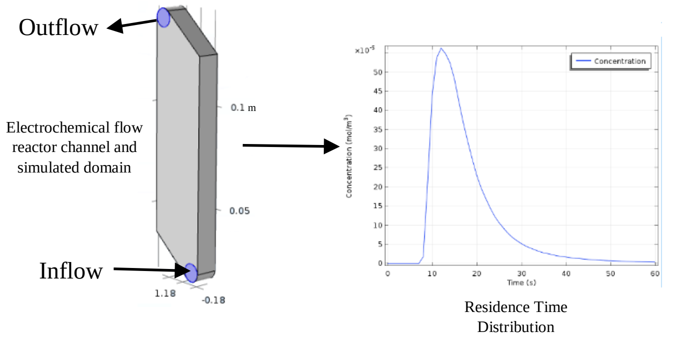
Electrochemical oxidation is one the most efficient methods of advanced oxidation processes for treatment of industrial wastewaters containing organic pollutants [1]. This method is in fact considered eco-friendly. scale-up or improving an electrochemical process requires controlled reaction medium around electrodes which enables us to vary mass transport rate and to obtain relations between mass transport and applied electrical current for various size and shapes of electrodes or fluid flow channel [2]. Most of pioneering lab-scale electrochemical studies consider a parallel electrode configuration in a simple beaker for electrochemical cell. This simple configuration is convenient, but reaction medium is hardly controlled and hard to scale-up [3]. Further advanced studies require pumping the reacting fluid flow into a reactor with defined characteristics which possess homogenous flow distribution along electrodes [4]. Therefore, in this study, we aim to obtained residence time distribution of a flow electrochemical cell through injection of a tracer into flow channel and numerical simulation by solving Navier-Stocks and convection-diffusion equations numerically in 3D space in order to calculate dispersion coefficient. Dispersion coefficient was calculated for 3 different flow rates in order to study effect of flow rate on deviation from ideal plug flow model and to achieve better understanding of fluid flow behavior and mass transport inside electrochemical cell. Results are gathered in Figure 1. We conclude that by increasing flow rate, dispersion coefficient increases and at low flow rate, deviation from ideal plug flow due to stagnant zones becomes major.



Residence Time Distribution

Table. 1 Information on results of numerical simulation

Flow rate (L.min^{-1})	Residence time-τ (s)	Dispersion (m^2.s^{-1})
0.5	17.52	0.0118
1.5	7.25	0.0241
3.5	3.42	0.0301

Fig.1 summary of process.

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Spectroelectrochemical behavior of new Polypyridyl Osmium complexes

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Electrochemistry becomes an extensive scientific discipline, and a significant area of great interest for researches on analysis, chemistry, physics, energy conversion and storages and biology.[1] The combination of electrochemistry, and spectroscopy, supplying molecular vibrational process, leads to spectroelectrochemistry (SEC) as a new technique, which is generally defined as the application of spectroscopic methods to assay the changes initiated by an electrochemical system in an electrochemical cell.[2,3] Electrochemical reactions can be initiated by applying potentials to the working electrode, and the processes that occur are then monitored by both electrochemical and spectroscopic techniques. Transmission electronic and reflectancespectroelectrochemistry has proved to be an effective method for studying the redox chemistry of organic, inorganic and biological molecules, for investigating reaction kinetics and mechanisms, and for exploring electrode surface phenomena. Oxidation states are changed electrochemically by addition or removal of electrons at an electrode while spectral measurements on the solution adjacent to the electrode are made simultaneously.Spectroelectrochemical techniques are convenient methods for obtaining spectra and redox potentials and for observing subsequent chemical reactions of electrogenerated species.[4] SEC measurements have also been used as a powerful tool for probing the electronic transitions and electrochemical processes of transition metal complexes with polypyridyl ligands.[5]

Here, we report the facile synthesis and characterization of new polypyridyl osmium complexes with polypyridyl ligands including 2,2′-bipyridine and 2,3,5,6-tetrakis(2-pyridyl) pyrazine. Further, the spectroscopic, electrochemical and spectroelectrochemical properties of the synthesized complexes were fully investigated.

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Electrochemical oxidation of 2,3-dihydroxybenzoic acid in the presence of potassium nitrite

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2,3-Dihydroxybenzoic acid is incorporated into various siderophores, which are molecules that strongly complex iron ions for absorption into bacteria [1]. 2,3-Dihydroxybenzoic acid is present in blood plasma and urine of healthy human volunteers after aspirin ingestion [2]. In this work, we study Electrochemical behaviour of 2,3-dihydroxybenzoic acid in aqueous phosphate buffer solution(pH=6.0) in the presence of potassium nitrite. The electrogenerated 2,3-dionebenzoic acid is converted to 2,3-dihydroxy-5-nitrobenzoic acid and 2,3-dihydroxy-4-nitrobenzoic acid with ECE mechanism on the carbon electrode. This work has led to the development of a high yield, green, reagent less and facile electrochemical method for the synthesis of the described nitro derivatives.

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The influence of PPy and EPDOT: PSS electrodes on the actuation performance of muscle-likeionic actuators

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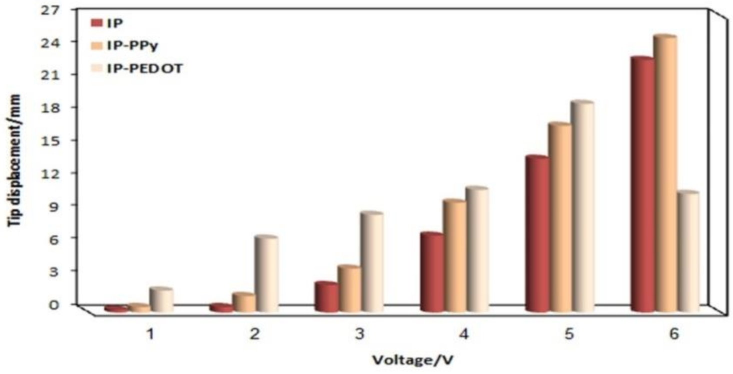
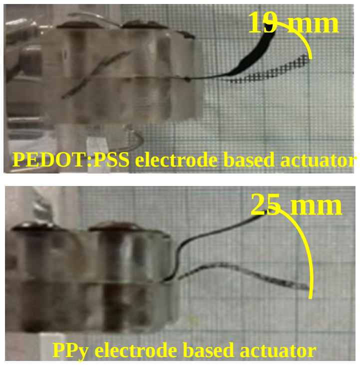
Ionic Polymer–Metal Composites (IPMCs) are promising candidates for the construction of soft actuator devices [1]. A typical IPMC is prepared from a thin cation-exchange polymer membrane (mostly Nafion), through which ions of single or multiple charge can pass, by depositing metal electrodes at both of its faces. Conventional Nafion-based IPMC actuators have a serious drawback of poor durability under long-term actuation in open air, mainly because of the leakage of the hydrated cations through cracks in the metallic electrodes [2]. To overcome this problem replacing conventional electrode materials with flexible conducting materials has been proposed [3]. In this project, as alternative to precious platinum electrodes in ionic polymer metal composite (IPMC) actuators, Polypyrrole (PPy) and poly(3,4-ethylenedioxythiophene): poly(styrenesulfonate) (PEDOT:PSS) electrode-based actuators were successfully fabricated by electropolymerization of these polymers on both sides of the Nafion membranes. The electrochemical characteristics of the actuators were investigated using cyclic voltammetry (CV), charge- discharge and electrochemical impedance spectroscopy (EIS). The physical and structural properties of actuators were characterized using water uptake (WUP) and ion exchange capacity (IEC) determination methods and scanning electron microscopy (SEM). The largest tip displacement (25 mm) was obtained in PPy-electrode actuators, in response to 6V dc potential. These actuators exhibited the highest specific capacitance of 146.26 mF.cm^{-2} and capacitance retention of 87.41% after 100 cycles. The electro-mechanical energy efficiency and the maximum tip displacement of PPy-electrode actuators were 46.42% and 31.57% higher than that considered for PEDOT:PSS-electrode actuators, respectively.





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Electrochemical study of Core–shell structured ZrO_2@MBT nanocomposites as anticorrosive pigment in epoxy coatings on mild steel

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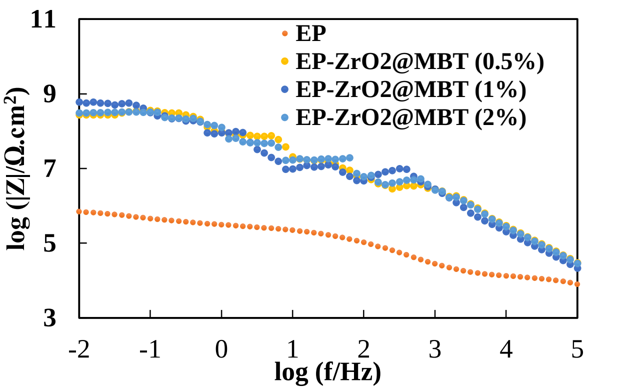
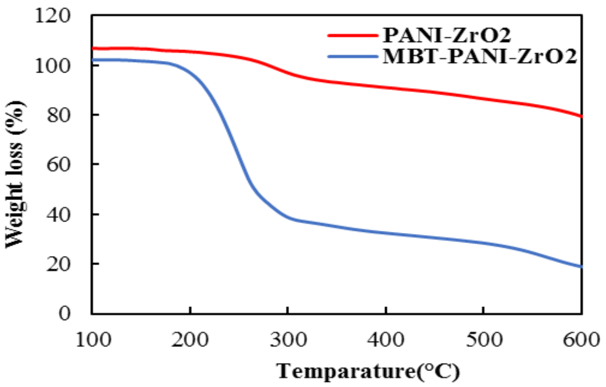
Epoxy coatings have been extensively used as protective coatings for steel structures [1]. In recent years, the researchers focused on the enhancement of anticorrosive performance of epoxy coatings by addition of modified nanoparticles. [2] In this research, the surface of ZrO_2 nanoparticles was modified with an effective corrosion inhibitive pigment (2-mercaptobenzothiazol (MBT)) via layer by layer assemble. At first, the surface of nanoparticles was coated by polyaniline via oxidative polymerization to form positive charges. Then, the MBT layer was deposited on the polyaniline due to the opposite electrostatic charges. The synthesized ZrO_2@MBT was investigated by Fourier transform infrared spectroscopy (FTIR), Raman spectroscopy, thermogravimetric analysis (TGA), Dynamic light scattering (DLS) and Zeta potential (ZP). The anticorrosion performance of epoxy coating on mild steel in the presence of different concentrations of ZrO_2@MBT (0.5, 1 and 2 wt%) was evaluated in saline electrolyte by electrochemical impedance spectroscopy (EIS). The optimum percentage of embedded ZrO_2@MBT in the epoxy coating was obtained 1 wt%. The values of total impedance modulus at 100 mHz (|Z|0.01 Hz) were 6.92×10^5 Ωcm^2 and 6.02×10^8 Ωcm^2 for the neat epoxy (EP) and EP/ZrO_2@MBT 1wt%, respectively at the end of immersion time (200 h).



|Z|0.01 Hz of coatings at the end of immersion time (200 h)



TGA of nanoparticles

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Monitoring the inhibition effect of eugenol on the xanthine oxidase activity: An analysis based on the electrochemical assay

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Xanthine oxidase (XO) is a systolic enzyme which generates reactive oxygen species such as superoxide radicals, when it catalyzes the oxidation of xanthine to uric acid.The over activity of this enzyme has a key role in several metabolic disorders such as inflammatory diseases, gout, hyperuricemia and chronic heart failure.[1] The inhibition of XO activity using inhibitors is one of the promising strategy for the treatment of its related diseases such as gout. Its synthesized inhibitors like allopurinol have some adverse effects, therefore, There is notable interest in the discover of new natural inhibitors. [2] Among the natural inhibitors, eugenol is very strong antioxidant which found in the essential oils of clove oil, basil, nutmeg and cinnamon.[3]Each subunit of this enzyme contains a molybdopterin cofactor, FAD, and two iron–sulfur centers which under goes a reaction and oxidation process.The generated electrons was readily donated to molecular oxygen, thereby producing reactive oxygen species.[4]A hybrid of reduced graphen oxide and carbon nanotube was used to design the enzymatic sensor for evaluation the inhibition effect of eugenol on xanthine oxidase. The obtained results from differential pulse voltammetry revealed that eugenol induces a decrease in activity of XO in oxidation of xanthine to uric acid. It seems that eugenol can block interaction of xanthine with enzyme. The inhibition of XO is the possible mechanism to prevent xanthine entry to the active site followed by reducing uric acid production in the presence of eugenol.

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Effect of Heat Treatment on the Electrochemical Capacitive Performance of Graphene oxide

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In this work, Graphene oxide (GO)was synthesis by modified Hummer’s method through oxidation of graphite [1]. Compared with deposition methods, Electrophoretic deposition (EPD) has attracted a lot of attention and the basis of this is that this method is cost-effective and easy way to deposition. GO is deposited on stainless steel mesh by anodic EPD because of negative charge of GO. The EPD's factors were optimized with regard to deposited mass. The EPD process was carried out under a DC voltage of 30 V and the deposition time of 20 min with constant concentration (3mg/ml). The mesh-GO placed in vacuum oven in different temperature to investigate thermal annealing. Morphology of the samples was characterized via scanning electron microscopy (SEM) analysis. Energy-dispersive X-ray (EDX) and FT-IR analyses confirm the reduction of GO with thermal annealing. Here in, water contact angle (WCA) measurement was used to study wettability of surface of annealed samples. Increasing thermal annealing temperature leads to decreasing wettability, WCA results show that the superhydrophilic steel surface is changed to superhydrophobic after deposition of GO and then thermal annealing at 200 ºC for 2h. On top of that influence of thermal annealing of GO on cyclic voltammetry (CV) and charge/discharge time are investigated. The electrochemical process was performedunder concentration of electrolyte solution 1M KOH. The results suggest that oxidation and reduction peaks were declined with increasing temperature of heat treatment. Comparison discharge time of samples show that an obvious decrease in discharge time.

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The use of electrochemical anodized aluminum foil as acathode current collector of lithium-ion battery

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The aluminum foil, used as a cathode current collector in a lithium-ion battery, plays a decisive role in battery cycle life through its ability to maintain active material on itself [1]. In this study, the surface of Al-foil was anodized by a simple electrochemical technique. Then, this modified collector was used in cathode electrode of Li-ion coin cell and compared with a bare-collector electrode. For preparing the modified collector, firstly, Al-foil (surface area of 25 cm^2) was rinsed with ethanol, and then immersed in potassium hydroxide and nitric acid solutions for 10 seconds, respectively. Subsequently, this foil was placedagainst a cathode of stainless steel in asolution of sulfuric acid. Current of 0.8 A was set up between the cathode and the anode to perform the anodizing process. The surface morphology of bare and modified aluminum foil was investigated using scanning electron microscopy. The wettability of the surface of the collectors was analyzed by the contact angle test via Data Physics OCA 15 plays instrument. In this method, a drop of normal methylpyrrolidone solvent is placed on the foil surface, and the contact angle created between the solvent droplet and the foil surface is immediately measured [2]. Active material ($LiNi_{0.8}Co_{0.15}Al_{0.05}O_2$), conductive additive (Super PLi) and binder (Polyvinylidene fluoride) were used to prepare the cathode electrodes. In order to determine the adhesion of cathode materials to the current collector surface, the test of immersion of electrode disk in electrolyte was used. The electrolyte used in this study was a solution of 1 M $LiPF_6$ salt in EC/DEC (1:1 v/v). To evaluate the electrochemical properties of cathode electrodes, coin cells were prepared in which lithium chips were used as anode and reference electrode, and then these cells were charged and discharged between 2.8-4.2 V at a rate of 0.5 C during 100 cycles via BTS8000 (Neware company). As shown in Fig. 1, the SEM images indicate a rough surface for anodized current collector and a relatively smooth surface for bare current collector. The results of the contact angle test indicate higher wettability of the modified aluminium foil against the bare foil. The high adhesion of active materials to the modified current collector was demonstrated through the test of electrode immersion in electrolyte. The cycleability results indicate that the modified-collector electrode has the ability to maintain a capacity of 85% in 100 cycles, but the bare-collector electrode retains only 66% of its initial capacity after 100 cycles.

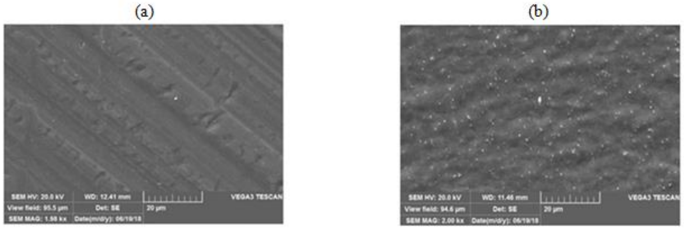

Fig.1. SEM Images of current collectors: (a) bare and (b) modified.

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Investigation on the water tanks corrosion of water-steam unit in Isfahan oil refinery and its controlling process with photoelectrochemical approach

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In recent years, the premature destruction of water treatment tanks and consequently the loss of practical longevity due to corrosion caused by aggressive microorganisms has been considered as one of the most significant industrial challenges[1-2]. as a reason of oxygen penetration possibility into water reservoirs, furether more the lack of sunlight and the water holdtime for just few hours, the bacterial growth probability and its replication index has got extended[3]. In this study, the corrosion process of galvanized carbon steel in the real enviornment for the water treatment unit of isfahan oil refining was assessed for selecting the appropriate treatment method such as photoelectrochemical methods[4], in order to prevent or reduce the microorganisms and so far the reduction corrosion. In this regard, X-Ray diffraction, the scanning electron microscopy tests on sediment, corrosion products of tanks in addition the SRB test on tank water were performed. Eventually the results indicate uncontrolled compounds of iron sulfide, iron oxide, calcium carbonate, magnesium oxide and silicon oxide. The outcomes also expose the microbial corrosion mechanism which is activated and exacerbated by impurities. In this survey, microbial corrosion mechanism with microstructural evidences will be discussed.

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Evaluation of a new gum from the roots of *Acanthophyllum bracteatum* as green corrosion inhibitor forcarbon steel in 2 M HCl solution

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In recent years, due to increased environmental warnings and needs to develop environmentally friendly corrosion inhibitors, the researchers have been great attention to natural products of plants [1, 2].Among the large number of plants, some of them, such assunflower seed hull extract [3], Glycyrrhiza glabra leaves extract [4] and Neem extract [5]have been reported as corrosion inhibitor of steel in corrosive environments.In this research, the inhibition action of a new gum from the roots of *Acanthophyllum bracteatum*on the corrosion of carbon steel in 2 M HCl has been reported. The corrosion behavior of carbon steel in acidic environment without and with various concentration of gum was studied by using the classical method of weight loss and electrochemical methods including potentiodynamic polarization method and electrochemical impedance spectroscopy (EIS) method. The results obtained from all three methods designated that the inhibition efficiency is highest for 2.0 g/L of gum and inhibition effect increased with increasing concentration of extract in order 2.5 g/L≈2.0 g/L >1.5 g/L>1.0 g/L>0.5g/L>0.1 g/L. Potentiodynamic polarization measurements in the temperature range of 25-65 °C was performed for different concentration of extract to define the effect of temperature on the behavior ofgum on the surface of carbon steel. The results indicated that the adsorption of gum is well described by Langmuir isotherm model for all of the studied temperatures.Thermodynamic adsorption parameters show that gum was adsorbed by a spontaneous exothermic process and a physisorption process can be suggested for that.

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Electrochemical Oxidation of 3,4-Dihydroxycinnamic acid in the Presence of 2-mercaptobenzimidazole Derivatives

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The oxidation–reduction reactions are a well-known type of electron transfer reactions, which play an important role in many areas of chemistry. The propensity of a molecule to donate or accept an electron in solution is measured by its standard redox potential and knowledge of standard redox potential is fundamental to understanding the chemical and biological electron-transfer reactions [1-2]. Since the electrode potential can be controlled over a wide range, a wide variety of electroorganic reactions are able to be designed in electrochemical synthesis [2]. As an electroactive substance, 3,4-Dihydroxycinnamic acid (Caffeic acid) has attracted much interest. Our previous studies show that the electrochemically generated *0*-quinonesare reactive intermediate and as a Michael acceptor, participates in different types of reactions [3-4]. Mercaptobenzazoles are known for their various biological activities such as antibacterial, antiviral, antiproliferative, and antifungal [5]. However, until now, no report has been published about the electrooxidation of 3,4-Dihydroxycinnamic acid **(1)** in the presence of 2-Mercapto benzimidazole derivatives. In this work electrochemical oxidation of 3,4-Dihydroxycinnamic acid **(1)** has been studied in the presence of 2-Mercapto benzimidazole (**3a**) 2-Mercapto-5-methoxybenzimidazole (**3b**) and 2-Mercapto-5-methylbenzimidazole (**3c**) as nucleophiles (Fig. 1).

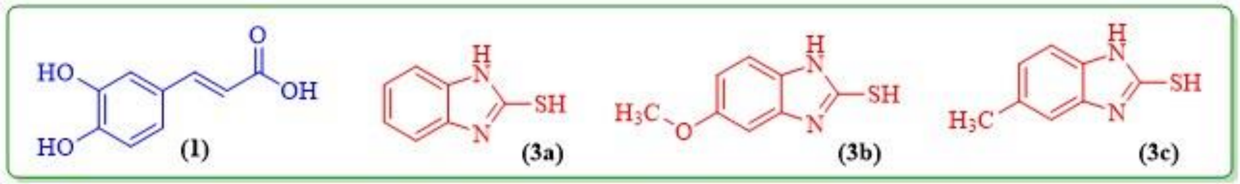

Fig. 1.

Some electrochemical techniques such as: cyclic voltammetry using diagnostic criteria derived by Nicholson and Shain for various electrode mechanisms and controlled-potential coulometry were used. Our results indicate the participation of electrochemically generated *o*-quinone in Michael-type addition reaction with 2-Mercapto benzimidazole derivatives (**3a–c**) to form the new corresponding cinnamic acid compounds.

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Synthesis of the *N,N*-Diethyl-1,3-benzoxazole-2-sulfonamideBased on the Electrochemical Oxidation of 2-Mercaptobenzoxazole in the Presence of the Diethylamine

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The organosulfur compounds play a very importantrole in various fields such as organic synthesis, materialsscience, agriculture, and medicinal chemistry. In particular, sulfonamide derivatives exhibit a wide range of biological activities such as anticancer, antibacterial, anticonvulsant, anti-inflammatory, and antiviral and HIV protease inhibitory activity [1]. Thus,synthesis of biologically and synthetically important sulfur-nitrogen bonds is one of the essential transformations inorganic synthesis. However, the limited availability of commercial starting materials, the formation of undesired by-products and/or harsh reaction conditions are the main drawbacks of these methods. Therefore, the search for novel and eco-friendly approaches to the synthesis of sulfur-nitrogen bond-containing compoundsis a challenge and open discussion. Along with this line, recently, oxidative coupling of thiols and N–H compounds has gained a lot of attention because of the eye-catching and promising properties [2]. To the best of our knowledge, the presented synthetic methods for the production of sulfonamide compounds still suffer from drawbacks so long-time conditions, un-safe and multi-step methods, high temperatures, using of organic and toxic solvents, and the employing of the expensive catalysts and toxic transition metals. With this in mind, we have developed a mild electrochemical procedure for the synthesis of asulfonamide compound by employingof the2-Mercaptobenzoxazole in the presence of the diethylamine, as a metal-free and catalyst-free procedure in room temperature and aqueous solution. As the first step, theexhaustively voltammetric survey as an easy-to-apply electrochemical technique has done in more details in order to shed more lights on the mechanistic aspect of this green electrochemical transformation under various conditions.The pH-dependence, scan rate effect, various solvents, and diagnostic tests have evaluated to obtainbetter insight into this reaction andinterpretation of the appeared diffusion-adsorption pattern that deduced to the proposing of the $E_1C_1E_2C_2$ mechanism. Based on theexperimental results and the previousreports [1], a possible reaction pathway was proposed asfollowing: Firstly, dimerization of electrogenerated thiyl radicals, undergoes the electrochemical over-oxidation to give benzenesulfonothioate as an intermediate. Then, the nucleophilicsubstitution of sulfonothioate by amine would leadto the formation of the desired sulfonamide. At the second step, the obtained optimal parameters have employed for theelectrosynthesis of above-mentioned sulfonamide at the constant current coulometry. The synthesis was carried out in an undivided cell equipped with the carbon and stainless steel as anode and cathode electrodes at the (H_2O: Ethanol; pH 8) mixture. The progress of the reaction wasmonitored by cyclic voltammetry and thin layer chromotagraphy and the final product precipitated by rotatory system and worked up after 6 h electrolysis. The full characterization of the obtained product by FT-IR, H-NMR, C-NMR, MS, and CHN confirmed the electrosynthesis of the*N,N*-Diethyl-1,3-benzoxazole-2-sulfonamideunderemployed conditions. The present procedure provides a green and cost-effective method for the synthesis of sulfonamides in high yield with the possibility of extending to the other starting materials.

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Electrochemical DNA biosensor based on Graphene–gold nanoparticle composite modified glassy carbon electrode for detection of PML/RARa fusion gene

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The sequence-specific detection of DNA is of great importance for molecular diagnostics, genetic diseases, environmental monitoring, and early screening of cancers [1]. Owing to their high sensitivity, small dimensions, low cost and suitability to miniaturization, electrochemical DNA sensors have been widely recognized as being a promising solution for point-of-care diagnostics [2, 3]. Due to the low concentrations of pathogen present before clinical symptoms become apparent, it is highly desirable to develop ultrasensitive methods for DNA detection [4]. In this work, a sensitive electrochemical DNA biosensor based on the partially reduced graphene-gold nanocomposite (PRGO-AuNPs) for DNA immobilization and enhanced hybridization detection is fabricated. The PRGO-AuNPs modified glassy carbon electrode (GCE) was fabricated and oligonucleotides were immobilized to the GCE. This electrode was used for detection of PML/RARa fusion gen related with actue promyelocytic leukemia. The hybridization reaction on the electrode was monitored by differential pulse voltammetry (DPV) and cyclic voltammetry (CV) techniques using electroactive methylene blue as an indicator. Scanning electron microscopy (SEM) was used to study the morphology of PRGO and PRGO-AuNPs. Also, fast Fourier transformation infrared spectroscopy (FTIR) and UV-Vis spectroscopy were used to confirm formation of graphene and graphene-gold composite. Then, the electrochemical behavior of PRGO-AuNPs modified electrode was studied by cyclic voltammetry (CV). The response signal increases linearly with the increase of the logarithm of the target DNA concentration in the range of 1.49×10^{-10} to 9.32×10^{-8} mol L^{-1} with the detection limit of 7.5×10^{-11} mol L^{-1} ($S/N = 3$). The linear regression equation is $I = 32.62 + 3.037 \log C_{\mathrm{DNA}}$ (mol L^{-1}) with a correlation coefficient value of 0.9842.

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Electrochemical detection of DNA hybridization based on MWCNT-AuNPs modified electrode

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DNA hybridization biosensors hold an enormouspotential for disease diagnosis, drug screening orforensic applications [1]. While many hybridizationdetection assays are suitable for diagnosis laboratories, faster, lower cost, easier-to-use and more sensitiveapproaches are highly desired, especially in thecase of decentralized screening of infectious diseases. In this context, DNA electrochemical biosensors withthe nucleic acids directly immobilized on an electrodesurface for hybridization offer innovative routes [2–5]. In this work, an electrochemical biosensor based a glassy carbon electrode (GCE) modified with MWCNTs-Chitosan-AuNPs nanocomposite was fabricated for the detection of specific sequence of DNA. Immobilization is based on the covalent reaction between thiol group in DNA probe and Au NPs on electrode surface. Cyclic Voltametry (CV) and Differential Pulse Voltammetry (DPV) techniques were used for hybridization detection by methylene blue (MB) as indicator. The surface modification increased significantly DNA immobilization quantity and complementary DNA detection sensitivity. The response signal increased linearly with the increase of the target DNA concentration in the range of (1×10^{-14} M to 9×10^{-14} M) with the detection limit of 7.2 fM. The presented method exhibited excellent specificity and selectivity for complementary and single-mismatch dsDNA after hybridization.

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Construction of an electrochemical sensor using clay and platinum-osmium nanoparticles for electrooxidation of methanol

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Fuel cells, the energy converting devices with a high efficiency and low/zero emission, have been attracting more and more attention in recent decades due to high-energy demands, fossil fuel depletions, and environmental pollution throughout the world [1]. Direct methanol fuel cells (DMFCs), using liquidand renewable methanol fuel, have been considered to be a favorable option in terms of fuel usage and feed strategies [2,3]. In this research project, a new electrochemical sensor was fabricated for electrooxidation of methanol using clay and platinum-osmium nanoparticles. For this purpose, a certain volume of clay solution was dropped firstly on the surface of flourin tin-oxide (FTO) plates. Then, the surface was coated electrochemically with platinum and osmium nanoparticles. The morphology and microscopic structure of the nanocomposite film formed at the surface of electrode were characterized by scanning electron microscopy and energy dispersive X-ray analysis. The electrocatalytic activity of the Pt-Os/Clay/FTO modified electrode was compared with Pt/FTO and Pt/Clay/FTO electrodes using cyclic voltammetry and chronoamperometry techniques and it was found that the Pt-Os/Clay/FTO electrode has a better performance for oxidation of methanol.

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Electrochemical detection and determination of diosgenin by molecular imprinted polymerelectrosynthesized on GlassyCarboneElectrode

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Bioactive components in medicinal plants are substantial resources for new drug production. Diosgenin is a sapogenin steroid that has been found in plants like *Trigonella foenum graecum linn* [1]. It shows anti- cancer effects [2] and anti-diabetic activity [3]. Sorbent for SPE was recently synthesized by MIP, Stefan-Ovidiu Dima and colleagues who synthesized MIP by wet phase inversion for diosgenin separation [4]. At present, a new electropolymerized molecularly imprinted polymer (MIP) film based on diosgenin has been synthesized on a glass carbon electrode (GCE). Para-aminobenzoic acid (PABA) was selected as the appropriate monomer from five functional monomers using Gaussian software for MIP production based on the density functional theory (DFT) method. It is an inexpensive and non- toxic monomer. The condition of MIP synthesis was optimized and the imprinting effect was confirmed by the electrochemical reaction of MIP to non-imprinted polymers (NIPs). The calibration curve of diosgenin on MIP/GCE was obtained with a linear range of 0.003- 0.13 mM. The limit of detection (LOD) and limit of quantification (LOQ) were obtained to be 8.95×10^{-4} and 2.98×10^{-3} mM, respectively. This method has demonstrated a good stability, high sensitivity and selectivity for diosgenin. The developed method was successfully applied for for real sample analysis of diosgenin in Trigonella foenum graecum seed extracts with proper sensor efficiency that was not significantly affected by the real sample's matrix.

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Electrochemical Detection of Adenine by ZnO Modified Pencil Graphite Electrodes

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Nowadays, the design of effective non-enzymatic biosensor for determination of nucleotides in physiological environments has concerned several attentions. Adenine is a purine base and the basic building blocks of deoxyribonucleic acid (DNA) and ribonucleic acid (RNA)[1, 2]. The abnormal changes of purine bases may lead to the mutation of gene information, implying the deficiency of the immunity system and the presence of various diseases such as cancer, epilepsy, HIV and lupus erythematosus[3]. Therefore, the determination of adenine is valuable for scientists.

Recently, zinc oxide nanoparticles have been attracted much attention for bio-sensing applications due to the high chemical stability, electron mobility, electrochemical activity, and surface-to-volume ratio[4]. In the present work, the ZnO nanoparticles were electrodeposited on the pencil graphite electrodes (PGEs) surface by applying chronoamperometry at constant potential of -0.8 V for 120 s in the $Zn(NO_3)_2$ solution (1mM$Zn(NO_3)_2$ and 0.1M $NaNO_3$as optimized condition). The electrochemical behavior ofsensor in the presence of various concentrations of adenine (ranging from 10 to 500 µM) on the ZnO modified PGEs in the 0.1 M phosphate buffer solution (pH=7) was investigated by a potentiostate/galvanostate device in the cyclic voltammetry (CV) mode (Fig. 1). It was found that the modified electrodes exhibit an excellent electrocatalytic activity towards the oxidation of adenine even at sufficiently low adenine concentrations. The experimental detection limit was obtained to be around 1μM and the linear dynamic range was at least from 1µM to 500µM.The favorable activity of electrode was concluded from the high intensity oxidation peak, positioned around the 0.97 V vs. Ag/AgCl.

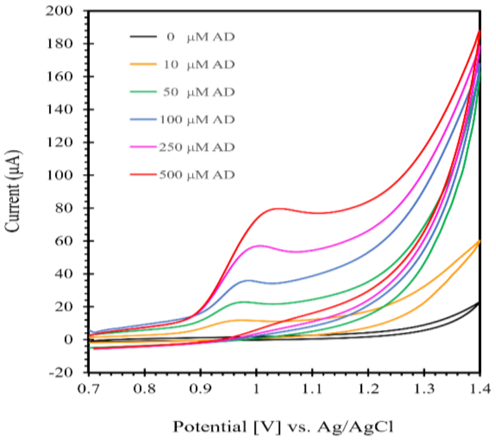

Fig. 1. CVs of adenine (0-500 µ M) on the ZnO modified PGEs in 0.1 M PBS (pH 7) at scan rate of 100 mV s^{-1}.

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Electroanalytical evaluation of Sarcosine as a new biomarker for prostate cancer using a carbon paste electrode modified with TiO_2 nanoparticles

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Recently, Sarcosine has been identified as a key metabolite marker for monitoring and early diagnosis of metastatic prostate cancer (PCa) and it is detectable in the urine of patients[1].

In present study, we reported an application of a carbon past electrode modified with TiO_2 nanoparticles in 1-Butyl-3-methylimidazolium tetrafluoroborate ionic liquid as highly sensitive sensors for voltammetric determination of sarcosine. Cyclic and differential pulse voltammetric methods were used to evaluate sarcosine electrochemical behaviour. Electrochemical oxidation of sarcosine on the new TiO_2-ionic liquid carbon paste electrode (TiO_2/IL/CPE) was carefully studied. The oxidation peak potential appeared at 1.09 mV vsAg/AgCl reference electrode on the modified electrode. The differential pulse voltammetric peak current increased linearly with sarcosine concentration in the range of 100 to 5000 µmol L^{-1} and the detection limit is 77 µmol L^{-1} (3σ) in phosphate buffer (pH=11.5). The RSD% for 600 µmol L^{-1} sarcosine for interday and intraday assay is 1.7 and 3.5 respectively.

Finally, electrochemical impedance spectroscopy was used to study the charge transfer properties at the electrode–solution interface.

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A novel sensor based on carbon paste electrode with Deep Eutectic Solvents for Enhanced Electrochemical Oxidation and Detection of Acyclovir

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A carbon paste electrode (CPE) containing MWCNT, ZnO and deep Eutectic solvent (DES) electropolymerized with L-arginine (Arg) has been tested as a new platform for acyclovir determination. Compared with the unmodified CPE, the MWCNT/ZnO/DES/PArg modified electrode exhibited high conductivityand excellent catalytic activity toward the redox of acyclovir, *(0.95 V)*. Two linear correlation curves between the current response and the acyclovirconcentration were obtained in the range from 0.01-0.09 μM and 0.12- 1μM, which can berepresented by a regression R^2 = 0. 997.The limit of detection of the sensor was calculated to be 0.65 μM. The prepared acyclovir sensor exhibited gratifyingsensitivity, selectivity and stability, and it was capable of sensing acyclovir in real samples with satisfying accuracy.

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Electrochemical sensing of naproxen and diclofenac using carbon paste electrode modified by $CoFe_2O_4$ nanoparticles

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Naproxen is an anti-inflammatory drug that widely used in the treatment of some diseases such as degenerative joint disease, rheumatoid arthritis, ankylosingspondylits. Diclofenac sodium also is another anti-inflammatory drug that widely used for treating a variety of painful diseases and inflammatory. Therefore, for the development of medication and therapeutic purposes, it is important to determine the low levels of diclofenac and naproxen in pharmaceutical and biological samples**.** So far, severalmethods have been employed for determination of naproxen [1, 2] and diclofenac [3, 4] in various types ofsamples.In this study, carbon paste electrode modified with $CoFe_2O_4$nanoparticle has been used for determination of naproxen and diclofenac. Different electrochemical methods such as differential pulse voltmeters, cyclic voltammetry, electrochemical impedance spectroscopy, chronoamperometry and chronoculometry were used to measure naproxen and diclofenac and to evaluate the electrochemical behavior of the modified electrode. Some parameters such as the amount of nanoparticles of $CoFe_2O_4$, pH effect, scan rate, step potential were optimized to improve the performance of the electrode for determination of naproxen and diclofenac.Optimum conditions were obtained at an electrode with 0.005 g $CoFe_2O_4$nanoparticles in a phosphate buffer solution with pH 6.5. Linear calibration curves were obtained in the range of 0.05-150 µM for naproxen and 0.1-200 µM for diclofenac.The detection limit of naproxen and diclofenac wereobtained 0.004 µM and 0.03 µM, respectively.The effect of a number of interferences species that existent in real samples was investigated on the electrode behavior when measuring a certain concentration of naproxen and diclofenac. The results showed excellent selectivity for electrode. The modified electrode was used to measure naproxen and diclofenac in real samples.

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Simultaneous and sensitive determination of benzenediol isomers using Zn-MOF modified carbon paste electrode by voltammetric method

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Hydroquinone (HQ), catechol (CT), and resorcinol (RC) are dihydroxybenzene isomers that are widespread in nature. Dihydroxybenze isomers are used extensively in the manufacture of various products (e.g. plastics, dyes, synthetic rubber, and household detergents) and can easily permeate into waterways. Furthermore, these are carcinogenic, and also can interfere with the endocrine system, even in trace levels. Thus, it is necessary to monitor or quantify these pollutants in complex systems [1].

Simultaneous determination of dihydroxybenzene isomers has become one of the important subjects for environmental analysis because they have similar structures and properties and coexistence in environmental samples. The electrochemical performance of carbon paste working electrode toward oxidation of isomers was improved by being modified by using Metal-Organic Framework for simultaneous determination of CT, HQ, and RC by voltammetric method. Metal−organic frameworks (MOFs), as a novel class of crystalline porous materials, are fabricated of inorganic metal ions/clusters linked by appropriate organic ligands, their unique characteristics such as highest surfaces area and adsorption affinity, adequate mechanical resistance, and thermal stability. The assembly of MOFs has drawn significant attention due to their fascinating structures and numerous potential applications in fluorescence, drug delivery, gas storage/separation, chemical sensing, magnetism, catalysis, pollutant control, antibacterial materials, and etc. [2]. MOFs have attracted much attention for applications in electrochemical sensors, because of their unique chemical and physical properties including ultrahigh porosity, large surface area, tunable structure, and high thermal and chemical stability. In this work, we have developed an electrochemical sensor using a carbon paste electrode modified by Zn-MOF for the simultaneous detection of HQ, CC, and RC dihydroxybenzene isomers. A good separation between the HQ, CC, and RC peaks allows us to simultaneously measure the dihydroxybenzene isomers using the differential pulse voltammetric (DPV) or cyclic voltammetric (CV) techniques. The proposed sensor delivered a linear dynamic range for HQ 10^{-7} – 10^{-3}µM, CT 10^{-7} -10^{-3} M, and RC 10^{-7}-10^{-3}µM with the detection limit of 0.3 pM. Thus, we decided fabricate a sensor modified by synthesized MOF in order to measuring this isomer simultaneously.

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Amperometric detection of Periodate based on glassy carbon electrode modified by nano-ruthenium oxide/ celestine blue nanocomposite

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Periodate, polyatomic anions with the chemical formula IO_4^- is an important oxidant which can oxidize many inorganic and organic compounds [1]. On the other hand, an excess of periodate can cause goiter and hypothyroidism as well as hyperthyroidism. Thus, the determination of iodine compounds, especially periodate, is of critical importance in a variety of fields [2]. A rapid, simple and new electrochemical method based on a glassy carbon electrode modified with ruthenium oxide nanoparticles (RuOxNPs) and celestine blue (CB) for detection of periodate has been developed. Surface physical characteristics of modified electrode were studied by scanning electron microscopy (SEM). Cyclic voltammetry and amperometry have been used for the investigation of the electrochemical properties and electrocatalytic activity of the nanocomposite-modified electrode. The detection limit, sensitivity and linear concentration range for periodate detection were 0.47 µM, 13.6 nAµM^{-1} and 5µM to 6000µM for GC/RuOx/CB modified electrode, respectively. The charge transfer coefficient (α) and the charge transfer rate constant (K_s) for electron transfer were calculated as 0.48 and 6.9 s^{-1} respectively. The modified electrodes indicated good electrocatalytic activity toward periodatte reduction and this sensor was applied for the detection of periodate in low potential.

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Preparation of Carbon Paste electrode modified by molecularly imprinted polymers and $NiFe_2O_4$nanoparticles for determination of methocarbamol

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Methocarbamol is used as an adjunct in the short-term symptomatic treatment of painful muscle spasms associated with musculoskeletal conditions and is sometimes given with analgesics for musculoskeletal pain treatment [1]. Methocarbamol is easily absorbed from the intestine and widely distributed in all body tissues. Because of potential for severe side effects, this drug is on the list for high risk medications in the elderly [2,3]. A carbon paste electrode modified with $NiFe_2O_4$nanoparticles and molecularly imprinted polymer (MIP)was developed for determination of methocarbamol. A noncovalent MIP was synthesized using methacrylic acid (MAA) as functional monomer, ethyleneglycoldimethacrylate (EGDMA) as crosslinker and methocarbamol as template, in polymerization solvent and was characterized by furrier transforms infrared (FTIR) spectrometry. The effect of various experimental parameters including percentage of MIP/$NiFe_2O_4$nanoparticle, pH andscan rateon the voltammetric response of methocarbamol was studied. The electrochemical behavior of the $NiFe_2O_4$nanoparticle-MIP carbon pasteelectrode was investigated by cyclic voltammetry and differential puls voltammety. At the optimum conditions, the concentration of methocarbamol was determined using DPV in a linear range of 7.07×10^{-6} to 2.1×10^{-4} mol L^{-1} with a correlation coefficient of 0. 999.The limit of detection (LOD) was found to be 6.2×10^{-6} mol $L^{-1}$and the recovery and relative standard deviation (RSD%) of the method were higher than 97.3% and lower than 3.6%, respectively. The proposed method was successfully applied in the determination of methocarbamol in pharmaceutical and human serum samples.

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Mesoporous Layered double hydroxidenanoparticle/tetra bromophenol blue dyeas a novel electrochemical platform for determination of ascorbic acid

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A new approach for detection of ascorbic acid was successfully performed based on adsorbed tetra bromophenol blue (TBPB) dye on a novel mesoporous Layered double hydroxide nanoparticle modified glassy carbon electrode (meso Co/Fe-LDHNPs /GCE). The characterization of obtained meso-Co/Fe LDHNPs [1] were monitored by a field emission scanning electron microscope (FE-SEM), X-ray diffraction (XRD), fourier transform infrared (FT-IR) and N2 adsorption-desorption isotherm. The adsorbed TBPB on meso Co/Fe-LDHNPs /GCEin pH 4.2 of dye solution were electroactive. A pair of symmetrical redox peaks at a formal redox potential, E = 0.27 V vs. Ag/AgCl (pH 7.4) was observed.

The TBPB/meso-LDHNPs/GCE showed excellent electrocatalytic activity towards ascorbic acid in buffer phosphate solution pH 7.4. The anodic peak current observed in differential pulse voltammetery (DPV) was linearly dependent on the ascorbic acid concentration. It was revealed that this system was highly sensitive for ascorbic sensing over the concentration range 80-500nM and limit of detection 5nM. This proposed electrode system resulted in a good detection limit, so that designed meso Co/Fe-LDHNPs /GCE had dramatically enhanced electrocatalytic activity towards for ascorbic acid with very high stability in compare reported probe for ascorbic acid sensing. The selectivity of designed probe for ascorbic acid was achieved by examines major interferences such as cysteine, uric acid and gallic acid.

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Investigating the relationship between temperature and pH in the production of biogas due to bio-electrochemical reactions of VFAs production and removal of COD in the anaerobic reactor of the Zar Grain Refinery

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Anaerobic digestion is known as a useful and cost-effective bio electrochemical process that converts complex and insoluble organic compounds into wastewater using anaerobic sludge to biogas. This study, the production of biogas by anaerobic reactor of Zar Grain Refinery wastewater treatment was investigate using a EGSB anaerobic reactor working capacity 900 m^3 and loading capacity 4000m^3/day sewage from glucose and fructose production. Characterizations Temperature, pH, COD raw sewage, COD outlet reactor, volatile fatty acids (VFAs), retention time, rotary flow rate in the reactor and biogas production was determination. The results show the importance of producing VFAs in reactor efficiency. In the lowest VFAs was recorded at temperature range of 35-37 °C and pH 7.4-7.8. Also has been proven that VFAs reduction has led to increase in the production of biogas and the efficiency of the removal of cod in the anaerobic reactor. The reduction of VFAs means that bio electrochemical reactions) hydrolysis, acidgenesis, Acetogenesis and methanogenesis) have been performed with high efficiency.

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Electrocatalytic effect of silver nanofibers/ionic liquid nanocomposite: Electro-oxidation of hydrazine

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Hydrazine is an ideal fuel for direct fuel cells given that hydrazine oxidation only generates environmentally friendly nitrogen and water. Also, the absence of carbon atoms in hydrazine leads to zero production of species that may poison the electrocatalyst [1,2]. Therefore, development of efficient electrocatalyst for the oxidation of hydrazine is very important. Electrochemical oxidation of hydrazine is kinetically sluggish and relatively requires high overpotential [3]. To improve the performance of fuel cells operating on hydrazine fuel, it is of great importance to develop the electrocatalyst layers with good activity for hydrazine oxidation. This work is focused on the study of efficient nanostructured silver fibers and ionic liquid electrocatalyst for the oxidation of hydrazine. Hence, hydrazine oxidation reaction is one of the most important reactions in electrochemistry due to its application in fuel cells. In fact, overcoming the large overpotential associated with the hydrazine oxidation is one of the major challenges, which call for the development of high-performance catalysts. The physico-chemical properties of catalyst materials were characterized by transmission electron microscopy, scanning electron microscope, electrochemical impedance spectroscopy and voltammetry. The morphology of the SFs consisted of 50 nm nanoparticles as the building blocks, and they possessed a specific surface area of about 25 m^2/g, which is sufficiently high for electrocatalytic applications. It was found that the nanocomposite film of silver fibers /ionic liquid exhibits excellent electrocatalytic activity towards hydrazine oxidation, resulting in a marked lowering in the peak potential and considerable improvement of the peak current. The improvement of electrochemical response to hydrazine oxidation was found at nanocomposite material, revealing the synergetic effect of SFs and IL.

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Electrochemical synthesis of polypyrrole/zeolite compositeas the sorbent materialfor extraction of phthalate esters from aqueous samples

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Electropolymerization of pyrrole in presence of Beta-zeolite was performed by using the method of constant potential, resulting in electrodeposition of polypyrrole (Ppy)/zeolite composites on the electrode surface. A solid phase microextraction (SPME) method in combination with liquid desorption and gas chromatography-flame ionization detector (GC-FID) has been developed for the extraction and determination of phthalate esters, di-n-butyl phthalate (DBP), di-iso-butyl phthalate (DIBP), n-butylbenzyl phthalate (BBP) and di (2-ethylhexyl) phthalate (DEHP) in water samples [1-3]. Ppy/zeolite composite coating was chosen as the sorbent for the SPME device. Under optimized condition, reproducibility and repeatability of the method were between 1.3- 5.6% and 1.9- 6.5 (N=5), respectively. The calibration graphs were linear in the range of 2-170 ng mL^{-1} and detection limits were between 1.5-2.8 ng mL^{-1}. The percent recoveries were between 81-114%. As real samples, various mineral and well waters were studied.

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Electro-oxidation of borohydrideon Porous Co/Ni-Ag nanostructures prepared by galvanicreplacement process

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Fuel cells are clean power generation devices whichconvertthe chemical energy of fuels into the electricalenergy. A direct liquid fuel cell utilizing liquid fuels such as methanol, ethanol, Hydrazine, and borohydride. Due to high theoretical specific capacity, easy transportation, high theoretical open-cell voltage a high hydrogen content, borohydrideis a promising fuelfor the direct liquid fuel cell. Using the noble metal catalyst towards borohydride oxidation reaction (BOR) is the important challenges to the commercialization of direct borohydride fuel cells. One method to solve this problem is the alloying of noble metals with non-noble metals such as Ni, Co [1-3].

In this work, the porous Co/Ni–Agelectrocatalyst was prepared by electrodeposition followed by galvanicreplacement process.The physical characterization of Co/Ni–Ag electrodes is investigated by field emission scanning electron microscopy and energy-dispersive X-ray spectroscopy. Cyclic voltammetry methodis used to study the catalytic properties of Co/Ni–Ag towards borohydride electro-oxidation in a conventional three-electrode cell.Experiments show that theCo/Ni–Ag electrode has a relatively good electrocatalytic activity towardsborohydride oxidation (Ip : 23 mA cm^{-2}).

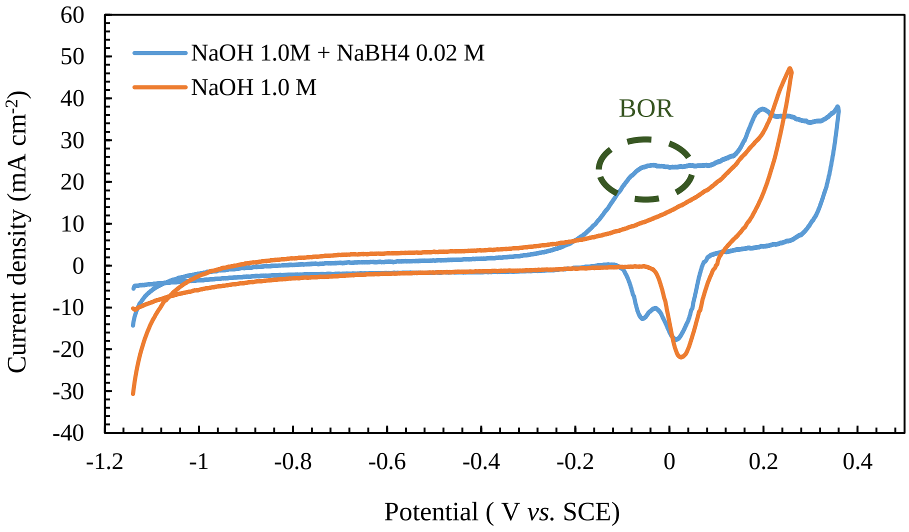

Fig. 1 The cyclic voltammograms of Co/Ni-Ag electrocatalyst towards borohydride oxidation at the scan rate of 100 mV s^{-1}

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Electrochemical Oxidation of Diclofenac in the Presence ofToluenesulfinic acid

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Electrochemical methods are widely used for the study of electroactive compounds in pharmaceutical forms and physiological fluids [1]. It is used for the synthesis of some new organic compounds due to their simple, accessible, and practical properties, in addition being consistent with the principles of green chemistry [2]. Also, Aryl sulfones are important synthetic targets. They are useful in the practice of medicinal chemistry. Our interest in the design and electrochemical synthesis of new compounds prompted us to synthesize new molecules under mild and ambient conditions [3]. In this work, the electrochemical behavior of Diclofenac has been studied in various pH values in the presence of Toluenesulfinic acid nucleophile in aqueous solutions. The results indicate that from oxidation of Diclofenac participates with arylsulfinic acids to form the corresponding new sulfone derivatives. The mechanism of anodic oxidation of Diclofenac has been successfully performed under constant current condition in good yield and purity in an undivided cell. The results indicate oxidation of Diclofenac in the presence of Toluensulfinic acid was happened by EC mechanism.

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Electrochemical study of Cu_2O/CuO composite coating produced by annealing and electrochemical methods. Application for electrocatalytic activation of CO_2

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Cu/Cu_xO/Ni is introduced as a new electrocatalyst for the electrochemical reduction of CO_2 at low overpotential in acetonitrile (ACN) solvent. Coating of CuO-Cu_2O (Cu_xO) nanosheets on copper foam was fabricated by an electrochemical anodization method in an alkaline solution [1]. Constant current coulometry method was used to electrodeposit Ni nanorods on the Cu/Cu_xO electrode surface [2]. Scanning electron microscopy (SEM) and X-ray diffraction (XRD) prove the copper oxide nanosheets are anchored on copper foam substrate and modified by Ni nanorods via a facile and inexpensive electrodeposition method. The copper foam used as substrate to provide the large surface areas for growing copper oxides nanosheets on its 3D frame. The results indicate that Cu/Cu_xO/Ni electrode has better electrocatalytic activity to reduce CO_2 than Ni and Cu/Cu_xO electrodes alone. This is probably due to synergistic effect between adjacent CuxO and Ni sites. The electrocatalytic reduction product of CO_2 (activated CO_2, $CO_2^{\bullet-}$) was used for electrocarboxylation of pyridine in mild conditions. By transferring an electron from $CO_2^{\bullet-}$ to pyridine, pyridine radical anion is formed. This radical anion, based on the EC′C′CC mechanism, reacts with $CO_2^{\bullet-}$ and produces isonicotinic acid [3]. The high stability of the proposed electrocatalyst during the electrolysis process and the simplicity of the workup make it attractive to use the proposed electrode for the electrosynthesis of isonicotinic acid.

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A comparative study of the electrochemical properties and pure contribution of each current in carbon paste electrodes based on different carbonaceous material as conductive phase by chemometrics method

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Different carbon paste electrodes were constructed from several carbonaceous material such as multi-walled carbon nanotubes (Functionalized and pristine form), graphite powder from Fluka and Merck company, pencil graphite and activated carbon, electrochemical characteristics of them were compared in K_4 [Fe (CN) $_6$] and Dopamine as two common benchmark redox system, by using multivariate curve resolution-alternating least squares (MCR-ALS)1, as a powerful chemometrics technique. Total current of them was deconvoluted to its three main current constituents including faradaic current, step charging current and induced charging current. The contribution of each type of current in total current can be related to the structure and composition of the electrode as well as the nature of the analyte and supporting electrolyte. The main focus of this study was on the contribution of faradaic current and nature of conductive phase in carbon paste electrodes. This approach can be effective for identification of optimal electrode material for voltammetric analysis and leads to new design criteria for carbon electrodes employed. The obtained results demonstrate that nature of conductive phase has a significant effect on faradaic current contribution. Results showed that activated carbon as conductive phases, show the worst responses and minimum contribution of faradaic current and functionalized multi walled carbon nanotube show the best response and maximum contribution of faradaic current compared to other carbonaceous material. Therefore, all aspects of the carbon materials such as wettability, structure, electrical conductivity and surface functionality can influence the electrochemical performance of carbon paste electrodes.

Electrochemical oxidation of 2,6-Dichlorophenolindophenol in the presence of benzenesulfunic acid

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2,6-Dichlorophenolindophenol(DPP) is part of the Hill reagents family, which has been widely used as a redox dye in determination of the rate of photosynthesis [1], vitamin C [2] and NADH [3]. It has also, acid-base indicator properties. Its color is red in acidic media and blue in alkaline media [4]. So, it is used as indicator in various acid-base titrations. The absorption spectra of the acidic and basic forms of the indicator are presented. In this work, electrochemical oxidation of DPP has been studied in the presence of benzenesulfunic acid in aqueous solution. The results showed that the electrochemically generated DPP_{ox}participates in Michael type addition reaction with benzenesulfunic acid and is converted to the corresponding new unsymmetrical arylsulfunic derivatives. The data show, some new unsymmetrical arylsulfunic derivatives are provided with high yields in aqueous solutions, without toxic reagents and solvents at a carbon electrode in an undivided cell using an environmentally friendly method.

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An electrochemical investigation on ZnO nanoparticles decorated methylene blue (MB/ZnONPs)

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With respect to the importance of Zinc Oxide Nanoparticles (ZnONPs) for biomedical applications and drug delivery, in this research the ZnONPs were successfully synthesized in a green approach then decorated with methylene blue and electrochemically were investigated. In compare with the methylene blue solution alone, the ZnONPs enhance the electrochemical activity of the methylene blue (MB) in a same concentration [1]. For electrochemical studies of the MB/ZnONP solution, conditions such as the pH, dye concentration and scane rate, were optimized. At the optimized conditions methylene blue in MB/ZnONP solution shows a well-defined redox couple at E^0 = -360 mV, which is comparable with MB solution alone at E^0 = -400 mV. Moreover, this MB/ZnONP solution was successfully applied to the determination of Fe (III) under optimal conditions. The proposed iron electrochemical sensor is based on differential pales voltammetry (DPV). The response of Fe (III) at this resulting voltammetric sensor has been found to work well in the concentration range of 10-80 µM with the detection limit of 2.5 µM. The selectivity of the proposed sensor for Fe (III) has been confirmed by the estimation of the Fe (III), influence of possible interferences such as Zn (II), Ni (II), Co (II) and Cu (II) on the Fe (III) signal response were tested.

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High-performance asymmetric and symmetric supercapacitors based on metal oxides and metal sulphides with graphene

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Supercapacitors illustrate a great technology to store energy for many applications including electrical automobiles, electronics, space and military purposes [1]. They are sustainable energy storage candidates because of their excellent power density and superior cycle life than batteries [2]. One of the main drawbacks of supercapacitors is their low energy density. Generally, two strategies are used to expand the operating voltage window of supercapacitors: (I) replacing aqueous electrolytes with non-aqueous electrolytes having wider redox windows; (II) designing asymmetric supercapacitors with different electrode materials for the cathodes and the anodes [3]. Along this subject, our group synthesized $NiGa_2S_4$-graphene composite on nickel foam by facile hydrothermal method with a superior specific capacitance of 2124.34 F g^{-1} and an outstanding energy density of 121.31 Wh kg^{-1} [4]. Additionally, we have suggested a straightforward route for the synthesis of Ni-Al LDH-graphene composite supported on nickel foam and employed prepared composite in flexible solid-state asymmetric supercapacitors. The Ni-Al LDH-graphene electrode exhibits an ultrahigh specific capacitance of 2693.25 F g^{-1} and excellent energy density of 214.4 F g^{-1} [5].

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GO–TiO_2–Pt-Os as a high-performance photoelectrocatalyst for direct methanol fuel cells

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Direct methanol fuel cell (DMFC) has attracted great attention in recent years because of its high energy density, low cost and easiness in transportation [1]. At present, the most frequently used catalyst material in DMFC is Pt, but pure Pt is rare and very costly. In addition, Pt catalyst tends to get poisoned by strongly adsorbed CO-like intermediates during methanol electrooxidation in acidic media, leading to severe limitations in the methanol oxidation kinetics [2]. In order to improve the activity of methanol electrooxidation, a common strategy is alloying Pt with other metals, such as PtIr, PtSn and PtRu [3,4].

In the present work, GO–TiO_2–Pt-Os nanocomposite was proposed as a new and high-performance photoelectrocatalyst forelectrooxidation of methanol. At first, a certain amount of graphene oxide (GO) and titanium dioxide (TiO_2) suspension was dropped onto the surface of the fluorine doped tin oxide (FTO) electrode. Then, the surface of the electrode was coated electrochemically with platinum and osmium (Pt – Os) nanoparticles. The surface of the modified electrode was characterized by scanning electron microscopy (SEM) and energy dispersive X-ray spectroscopy (EDX) techniques. The electrooxidation of methanol on the surface of the modified electrode was studied using cyclic voltammetry and chronoamperometry. Theobtained resultsshowthatthe GO–TiO_2–Pt-Os hasahighelectrocatalyticactivitytowardsthemethanolelectrooxidation reactionascomparedtoPtcatalyst.

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Hydrodynamic modelling and simulation of fuel cell with polymer membrane by COMSOL

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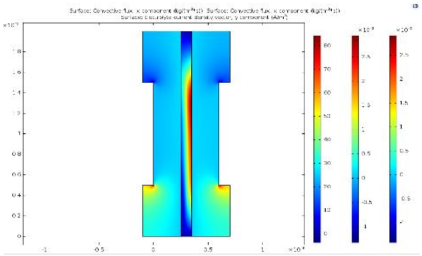
Fuel cells and hydrogen technologies offer a promising pathway towards sustainable energy systems. They offer the prospect of low to zero emission power generation for sub-watt to M-watt applications in transportation, heating, manufacturing, and communication [1,2]. Recently, several researchers succeeded in improving the self-humidifying performance with multiple-layered electrodes, by retaining the liquid water [2]. In this work, a fuel cell with polymer membrane has been investigated by using a homogeneous and one-dimensional model at steady state condition. Firstly, governing equations for this system were obtained [3,4]. For example, gas diffusion layer, oxygen transfer rate and ohmic losses were extracted. Secondly these equations were simulated by software of COMSOL and were calculated electrical potential changes. In the following, the changes of the electrical current density in the polymer membrane as well as the loss of concentration were calculated using a series of appropriate assumptions. The results showed that with increasing of electrical current density, the amount of cell efficiency was decreased (Fig.1), so that it reached to 25% at density of 12000 $A.m^{-2}$. In addition, the total voltage of the fuel cell is calculated base all drops. Also, the variation of the output voltage with time was determined. These results were agreed with experimental data. Furthermore, quantitative studies were carried out to investigate the mass transfer in the gas diffusion layer and the coupling of mass transfer equations, charge, and momentum transfer. The obtained results of these equations showed that polymer membrane should always be wet during the process, because the mass transfer rate will be much. Also change of the mass fraction in a fuel cell revealed that its amount in the cathode input and the anode output is maximum.

Fig.1. Variation of electrical current density



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Exploring the Electrochemical Stabilities of Ammonium, Phosphonium and Arsenium Alicyclic Ionic Liquid based Lithium Battery Electroytes

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To shed light on the stability of hetero-alicyclic ionic-liquids (ILs) as electrolyte in lithium metal batteries, we have computationally studied the electro- chemical windows of twelve distinguished ionic liquids versus Li^+/Li red-ox pair. Five, six and seven member rings containing nitrogen, phosphorous and arsenic atoms are investigated. The cation set include 1-R-1- methyl pyrrolidinium $[RmPyrr]^+$, 1-R-1-methylpiperidinium $[RmPiP]^+$, 1-R-1-methyl- βpiperidinium $[Rm\text{-}\beta PiP]^+$, 1-R-1-methylazepanium $[RmAzp]^+$ with R=MeOCH2CH2- and their phosphonium and arsenium counterparts. $[NTF2]^-$ is the common anion in all 12 ionic liquids. DFT calculations[1] are exploited to perform the geometrical optimization and free energy calculations in gas and solvated states at B3LYP/6-311++G(d,p) level of theory[2]. The integral equation formalizm polarizable continuum model (IEF-PCM) is used to account for solvation stabilization[3] as implemented in Gaussian09 quantum chemistry package[4]. In addition to single electron redox reactions, dissociations joined with these reductions and oxidations were investigated. It was found that arsenium compounds are the most stable and seven and five member rings perform better than six member rings. Also, the energetics of the broken of the ether functional was more favorable than other paths. We hope our work provide a novel path in new electrolyte design for lithium metal batteries

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Electrochemical Synthesized of the Diazo Dye

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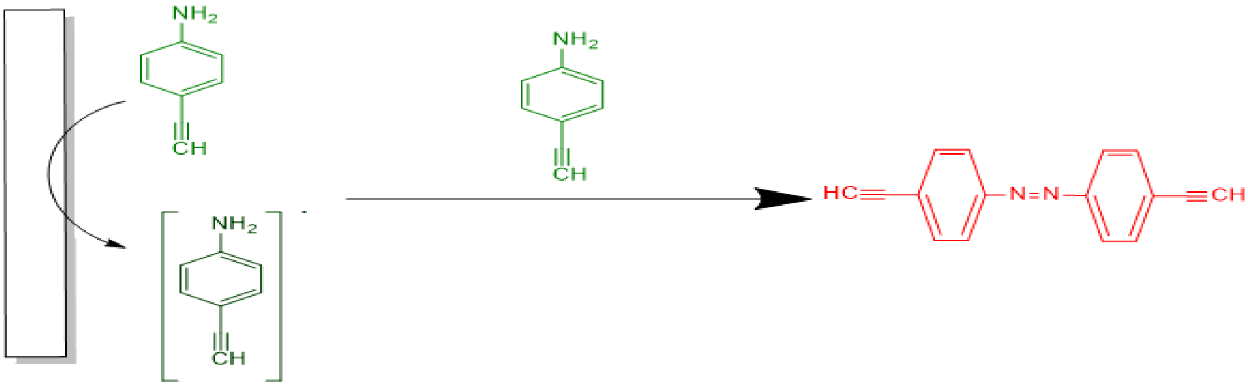
Aniline and phenylacetylene and their derivatives are important compounds in chemical industries [1]. Diazonium salts are highly useful intermediates in the synthesis of a large variety of aromatic compounds. These can be used to prepare many classes of organic compounds. Aryl diazo compounds are brightly colored and are useful as dyes and pigments so are classified as azo dyes. Azo compounds are good oxidizing agents and can be readily reduced back to hydrazine or a primary amine. Additionally, azo compounds have been utilized in various biological assays, as coupling agents, and in synthetic dyes [2]. Diazo compounds exhibit high synthetic versatility, spanning organic and inorganic chemistry. Diazo compounds can be used to couple and immobilize biomolecules onto surfaces [3]. In this work we study the electrochemical oxidation of 4-ethynylaniline, using coloumetery at controlled potential technique at the surface of the graphite electrode as a working electrode at various pH. The results revealed that the diazo compound was synthesis by 4-ethynylanilin at the specific pH in the divided cell using coloumetery at controlled potentials. The purity of product and characterization was done using ^{1}H NMR, ^{13}C NMR, FTIRspectroscopic techniques. The presented strategies use a water/acetonitrile mixture as solvent. These strategies represent a one-pot and facile process for the synthesis of diazo compound in high yield and purity.



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Green electrochemical nitration of Quercetin

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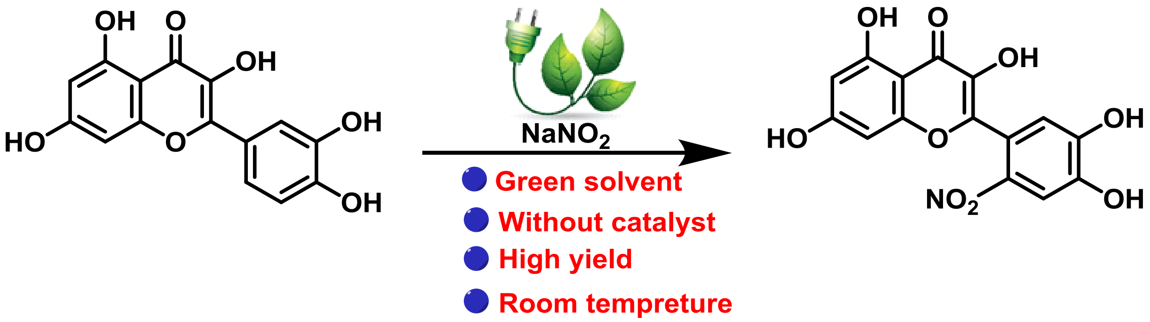
Nitro aromatic compounds are valuable materials because of their applications in the preparation of chemical intermediates for the synthesis of dyes, plastics, perfumes, energetic materials, and pharmaceuticals [1,2]. Chemical and electrochemical procedures are reported for nitration of aromatic compounds [3]. Quercetin is the flavonoid bioactive compound. Flavonoid derivatives are present in many vegetables and fruits and are constituent of many common pharmaceuticals and dietary supplement [4,5]. Electrochemistry provides very versatile means for the electrosynthesis, mechanistic and kinetic studies. To the best of our knowledge, and despite the importance of these compounds in numerous scientific fields, there are no reports on the electrochemical nitration of Quercetin. Herein, we describe a green electrochemical synthesis of a novel nitro compound. In this work, electrochemical oxidation of Quercetin has been studied in the presence of nitrite ion as a nucleophile in acetate buffer solution (c = 0.2 M, pH = 6.0), by means ofcyclic voltammetry and controlled-potential coulometry. The results indicate the participation of produced o-benzoquinones in Michael reaction with nitrite ion (in the divided cell) to form the corresponding nitro diol (EC mechanism). The purity of product and characterization was done using ^{1}H NMR, ^{13}C NMR, FTIRspectroscopic techniques. The presented strategies use a water/ethanol mixture as solvent. Ethanol as cosolvent was also used in the previous studies because of its low cost, safety, easy availability, recyclability, bioproductability, and biodegradability. These strategies represent a one-pot and facile process for the synthesis of new nitro compound in high yield and purity under green conditions.



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Iranian herb and spices 'Identitation'throughcyclic voltammetry fingerprint: Simultaneousof geographical origin& variety

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There are many herbs and spices widely consumed in our daily diet in IRAN and, indeed, worldwide. Since these herbs and spices are being consumed in daily diets or as supplements, it is important to determine their nutrient composition so that their effect on humanhealth can be understood [1]. It is also important to try to elucidate whether or not there are any relationships between different plant types and geographical origin. Chemometrics is the application of mathematical and statistical techniques to retrieve more information from the electrochemistry, spectroscopy and chromatographic data [2]. Among others, an unsupervised pattern recognition technique such as principal component analysis (PCA) is the most often used method for handling multivariate data without prior knowledge about the studied samples. While the supervised classification procedure using soft independent modeling of class analogy (SIMCA) and PLS-DA assign unknown samples into the predefine class [3]. In the present study, the analysis of cyclic voltammetry fingerprint of 50 different Iranian spice and herbs samples was carried out by applying chemometric tools effectively. Thus, the application of chemometrics techniques will greatly improve the quality of the results of fingerprint obtained. The results showed that these methods have the ability to detect brand samples from fake samples.

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Assessmentof SomeHerbal Medicines by Chemometrics – Assisted fingerprint of cyclic voltammetry data

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Plant medicines are often in focus of extensive research. The reason for this is the fact that medicinal plants are rich sources of not only biologically active substances, and also of vast pool of macro- and microelements [1]. These essential elements together with the organic compounds create natural complexes, in which all constituents are balanced, and can act simultaneously on the human organism. Many modern analytical approaches have been introduced to evaluate the quality of medicinal plants, and significant amount of measurement data has been produced [2]. Therefore, the application of chemometrics in the field of medicinal plants is spontaneous and necessary. In this study, fingerprint of cyclic voltammetry associated with chemometricsmethods (Principal Components Analysis, PCA and Soft Independent Modeling of Class Analogy, SIMCA) used for extracting useful information and quality evaluation of medicinal plants.

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Formation of Copper Oxide Film due to corrosion on generator’s neutral barat Qom Combined Cycle Power Plant

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In this paper the corrosion of generator neutral bar at Qom combined cycle power plant is investigated. Due to copper’s high conductivity and mechanical strength, its use as a conductor in generators output bars is widely used in the electrical industry. In this paper, the causes of copper oxide film formation on the copper bar in the generators neutral are investigated. Solutions to reduce the corrosion process in the mentioned neutral bar are searched and the corrosion factors are limited.

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Direct and pulse electrochemical deposition of Ni-B_4C nanocomposite coating

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In this research, Ni-B_4C nanocomposite is fabricated by electroplating process in watt solution under direct and pulse current conditions. In direct current conditions, effect of current density and nanoparticle concentration in the bath were investigated. In pulse current conditions, effect of frequency and duty cycle were investigated. Morphology and composition of the coatings were investigated by SEM and EDS analysis. In general, the amount of codeposited nanoparticles is higher in pulse current conditions (maximum: 7.4 wt. % in 10 Hz frequency 50% duty cycle). The optimum stirring rate for this bath is 250 rpm.

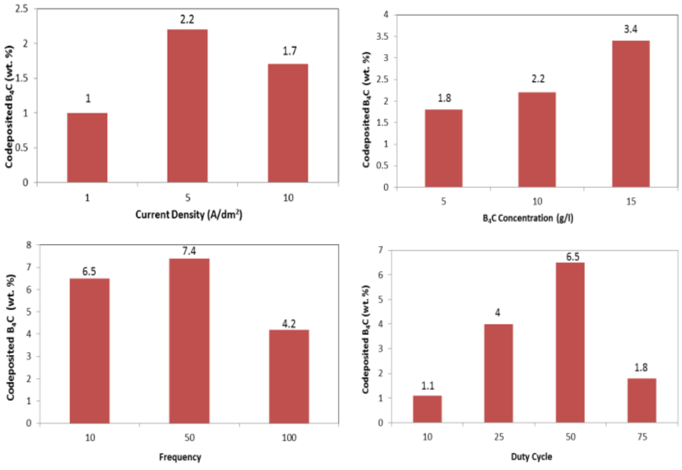

Fig.1. Codeposited amount of B_4C versus different electroplating parameters

References

[1] Low, C. T. J., Wills, R. G. A., & Walsh, F. C. (2006). ***Surface and Coatings Technology***,2006, 201, 371.
[2] Thiemig, D., Lange, R., & Bund, A. ***Electrochimica Acta***2007,52, 7362.
[3] Landolt, D., & Marlot, A. ***Surface and Coatings Technology***, 2003,169, 8.
[4] Nickchi, T., & Ghorbani, M. *Surface and Coatings Technology*, 2009,203, 3037.
[5] Frade, T., Bouzon, V., Gomes, A., & da Silva Pereira, M. I. (2010). ***Surface and Coatings Technology***, 2010,*204*, 3592.

Corrosion and wear characterization of Ni-B_4C nanocomposite coating fabricated by electrochemical deposition

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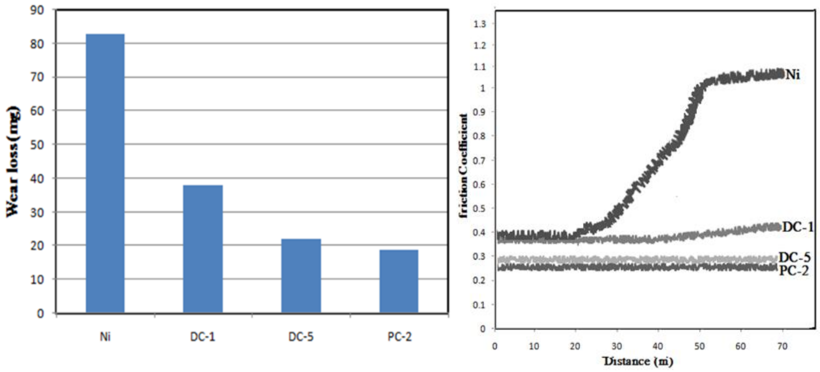

Fig.2. Wear result for different samples

References

[1] Low, C. T. J., Wills, R. G. A., & Walsh, F. C. ***Surface and Coatings Technology***,2006, 201, 371.
[2] Thiemig, D., Lange, R., & Bund, A. (2007). ***Electrochimica Acta***,2007, 52, 7362.
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