Electrochemistry and Multidisciplinary Applications

JEMA 2018

Organized by the

Tunisian Chemical Society

Bizerte Section

28-29 April 2018

Andaloucia Beach Hotel, Bizerte, Tunisia

Abstracts of Lectures and Communications
Participants' List

TUNISIAN CHEMICAL SOCIETY - Bizerte Section
Short Program of JEMA 2018

Saturday 28 April 2018	
09.00 - 10.00	**Welcoming participants, distribution of documents and check in**
10.00 - 10.15	**Official Opening of the JEMA 2018**
10.15-10.50	Plenary Lecture 1 **Armelle RINGUEDÉ** *Institut de Recherche de Chimie de Paris (IRCP)* *Ecole Nationale Supérieure de Chimie de Paris – Chimie ParisTech.*
10.50 - 11.35	**Oral Communication: Session 1 : OC01 - OC03**
12.30	***Lunch***
14.00 - 14.35	Plenary Lecture 2 **Ouassim Ghodbane** *Institut National de Recherche et d'Analyse Physicochimique, Laboratoire des Matériaux Utiles,* *Pôle Technologique de Sidi Thabet, Tunisie.*
14.35 - 15.20	**Oral Communication: Session 2 : OC04 - OC06**
15.20 - 16.00	**Poster Session 1 (P1 - P24) + Coffee break**
Sunday 29 April 2018	
09.00 - 09.35	Plenary Lecture 3 **Fethi Bedioui** *Unité de Technologies Chimiques et Biologiques pour la Santé, Chimie ParisTech-PSL Research University,* *Université Paris Descartes, Paris, France*
09.35 - 10.20	**Oral Communications - Session 3 : OC07 - OC09**
10.20 - 10.45	**Poster Session 2 (P25 - P48) + Coffee break**
10.45 - 11.45	**Oral Communications - Session 3 (*continuing*) : OC10 - OC13**
12.30	**Lunch**
14.00 -14.35	Plenary Lecture 4 **Yasser BEN AMOR** *ISSTE-Borj Cedria, Tunisia*
14.35 - 15.20	**Oral Communications - Session 4 : OC14 - OC16**
15.20- 15.30	**Closing and check out**

FOREWORD

On behalf of the organizing committee of “Electrochemistry and multidisciplinary applications” meeting JEMA 2018, we would like cordially to welcome you in Bizerte.

JEMA 2018 is a two days scientific meeting organized by the Chemical Society of Tunisia (section of Bizerte).The purpose of this meeting is to offer an update of recent innovations in both fundamental and applied aspects highlighting new advances in the field of electrochemistry.

The aim of this meeting is to discuss recent progress and challenges and to offer the delegate opportunities for cooperation and networking. The emphasis will be put on interdisciplinary, complexity and relation with other disciplines and on future directions.

The topics presented during these meetings cover electrochemical depollution, electrosynthesis and materials, corrosion and protection of materials, energy production and storage. The organizers would also like to make this meeting a discussion forumbetween scientists

The success of JEMA 2018 depends completely on the effort, talent, and energy of researchers in the field of electrochemistry applications who have written and submitted abstracts on a variety of topics. “Electrochemistry and multidisciplinary applications” meeting offers 4 plenary lectures, 16 oral presentations and 48 posters and the experiences of over 80 participants at this meeting.

Dear participant, thank you very much to share with us your research and experience in electrochemistry fields. Finally, we welcome you to Bizerte. We hope that you will take advantage of the many sights to see in the city, as well as the many natural wonders nearby, during your stay.

Yours with Kindest regards

Pr Rym ABIDI

General Secretary

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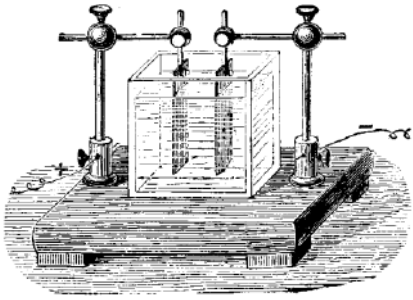
Being on time is the main factor for conference's success

Saturday 28 April 2018		
09.00 - 10.00	**Welcoming participants, distribution of documents and check in**	
10.00 - 10.15	**Official Opening of the JEMA 2018**	
10.15-10.50 *(30 mn speech + 5 mn discussion)*	Plenary Lecture 1 **Armelle RINGUEDÉ** **Impedance spectroscopy as a powerful electrochemical technique in high temperature devices for energy production** *Institut de Recherche de Chimie de Paris (IRCP) Ecole Nationale Supérieure de Chimie de Paris – Chimie ParisTech.*	*Chairman:* Pr. Fethi BEDIOUI
Oral Communication: Session 1 - *Chairman:* Pr Fethi Bedoui		
	Com.	*Communicating*
10.50 - 11.05	OC-01	ABDI Djemil
11.05 - 11.20	OC-02	ABIDLI Imène
11.20 - 11.35	OC-03	FRIKHA Nourzed
12.30	***Lunch***	
14.00 - 14.35 *(30 mn speech + 5 mn discussion)*	Plenary Lecture 2 **Ouassim Ghodbane** **Energy Storage in MnO_2–based Electrochemical Supercapacitors** *Institut National de Recherche et d'Analyse Physicochimique, Laboratoire des Matériaux Utiles, Pôle Technologique de Sidi Thabet, Tunisie.*	*Chairman:* Pr. Nizar BELAKHAL
Oral Communication: Session 2 - *Chairman:* Pr Sourour Chaabane Elaoud		
	Com.	*Communicating*
14.35 - 14.50	CO-04	BOUACHMA Souraya
14.50 - 15.05	OC-05	BOULARES Asma
15.05 -15.20	OC-06	DKHILI Samiha
15.20 - 16.00	**Poster Session 1 (P1-P24) + Coffee break**	

Being on time is the main factor for conference's success

Sunday 29 April 2018		
09.00 - 09.35 *(30 mn speech + 5 mn discussion)*	Plenary Lecture 3 **Fethi Bedioui** **Electroanalytical strategies for the detection of nitric oxide and associated species in biological systems** *Unité de Technologies Chimiques et Biologiques pour la Santé, Chimie ParisTech-PSL Research University, Université Paris Descartes, Paris, France*	*Chairman :* Pr. Salma BESBES HENTATI
Oral Communications - Session 3 - *Chairman:* Pr. Nizar BELAKHAL		
	Com.	*Communicating*
09.35 - 09.50	OC-07	EBDELLY Wahiba
09.50- **10.05**	OC-08	ABIDI Maali
10.05- 10.20	OC-09	GHAZOUANI Mouna
10.20 - 10.45	**Poster Session 2 (P25-P48) + Coffee break**	
10.45-11.00	OC-10	GRITLI Manel
11.00-11.15	OC-11	KAHLAOUI Radhouene
11.15- 11.30	OC-12	LAHBIB Hana
11.30 - 11.45	OC-13	MEJRI Rania
12.30	**Lunch**	
14.00 -14.35 *(30 mn speech + 5 mn discussion)*	Plenary Lecture 4 **Yasser BEN AMOR** **Electrochemical impedance spectroscopy and constant phase elements for corrosion investigations** *ISSTE-Borj Cedria, Tunisia*	*Chairman:* P Armelle Ringuedé
Oral Communications - Session 4 - *Chairman: Armelle Ringuedé*		
	Com.	*Communicating*
14.35 - 14.50	OC-14	MONCER Fatma
14.50 - 15.05	OC-15	RAHMOUNI Nihed
15.05 - 15.20	OC-16	SAIDI Malek
15.20- 15.30	**Closing and check out**	



Lectures

Impedance spectroscopy as a powerful electrochemical technique in high temperature devices for energy production

Armelle Ringuedé

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Fuel cells are electrochemical devices allowing the conversion of chemical energy into electrical energy. It consists as a first principle in the electrochemical combination of dihydrogen and dioxygen to produce water, thus a clean way to produce electricity. The interest in operating at high temperature, higher than 600°C, is first to increase conversion efficiencies, to consider also the valorization of the co-generated heat, to avoid the use of noble metals as catalysts and even to replace hydrogen by hydrocarbons as fuels.
After introducing the electrochemical devices developed for energy production, focusing on high temperature operation, I will illustrate the interest in carrying out impedance spectroscopy to measure the electrolyte conductivity, the electrode performances and determine electrode reaction mechanisms, the characterization of intrinsic properties of thin oxide layers, etc up to the basics of complete cell analysis, one of them dealing with the potential of in situ diagnostic.

Energy Storage in MnO_2–based Electrochemical Supercapacitors

Ouassim Ghodbane

Institut National de Recherche et d'Analyse Physicochimique, Laboratoire des Matériaux Utiles, Pôle Technologique de Sidi Thabet, Tunisie.

Electrochemical supercapacitors are currently extensively studied as auxiliary energy storage devices to be used with rechargeable batteries. Their applications include electric vehicles, renewable energy, mobile devices, d.c. power systems and uninterruptible power supplies. Many studies have focused on the development of MnO2 based materials because of electrochemical behavior, low cost and environmental compatibility. The large variety of MnO2 compounds that can be found as minerals or synthesized via various methods offers a wide range of opportunities for testing candidates for electrochemical supercapacitor electrode materials. On the other hand, the electrochemical performance of MnO2 based supercapacitors may be governed by numerous factors, including the composite microstructure, the specific surface area, the chemical composition, and the ionic and electronic conductivities. In the present work, seven crystallographic forms of MnO2 were synthesized and investigated as electrode materials for electrochemical supercapacitors. Figure 1 presents the crystal structures of the studied MnO2 compounds. The pyrolusite, ramsdellite, cryptomelane, todorokite and OMS-5 phases were built through 1D tunnels group, while the birnessite and spinel ones constituted the 2D and 3D groups, respectively.

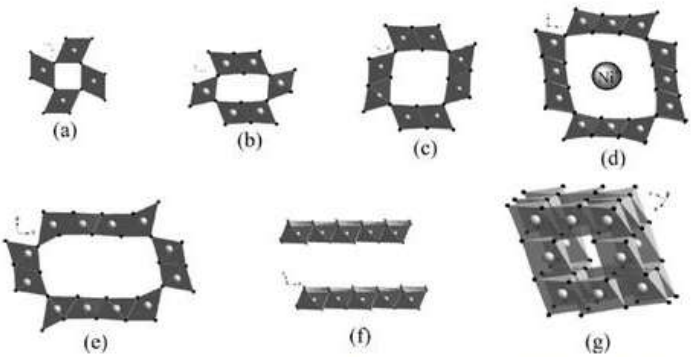

Figure 1. Crystallographic structures of MnO2 pyrolusite (a), ramsdellite (b), cryptomélane (c), Ni-todorokite (d), OMS-5 (e), birnessite (f) and spinel (g).

Electroanalytical strategies for the detection of nitric oxide and associated species in biological systems

Fethi Bedioui

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Nitric oxide, NO, is one of the ten smallest molecules found in nature and interest in its direct and real-time measurement originated from studies of its role as physiological messenger and cytotoxic agent in several biological systems [1]. Indeed, biologically, NO was first characterized in 1987 as endothelial-derived relaxing factor and it was reported that it is produced by endothelial cells in blood vessels and diffuses to the adjacent smooth muscles to cause vasodilatation [2]. Since this initial report that resulted in *R. F. Furchgott, L. J. Ignarro* and *F. Murad* receiving the Nobel Prize in Physiology and Medicine in 1998, there has been an explosion of research activity showing that NO release occurs not only from endothelial cells but also from neuronal, tumoral and immune system cells etc. The huge and intense research activities in these fields have resulted in more than 204 000 papers being published in the literature during the last 15 years. Many of the numerous properties of NO – that enable it to carry out its diverse physiological functions - also present considerable problems when attempting its detection and quantification in biological systems. NO is a free radical – that reacts very fast with oxygen, peroxides, O_2-radicals (superoxide $O_2^{\bullet-}$) and metals (and metalloproteins). This explains its fleeting existence and extremely low concentrations in biological systems [3].
The only strategies that allow direct, real time, label free and *in vivo* detection of NO, $O_2^{\bullet-}$ and their associated product $ONOO^-$ are those based on the use of ultramicroelectrodes [4,5]. Indeed, micro electrode design and fabrication are now reaching very high levels of sophistication, hence actively contribute to the promotion of the use of electrochemical techniques for *in vivo* NO, $O_2^{\bullet-}$ and $ONOO^-$ determination by offering the following characteristics: *(i)* good selectivity and efficient discrimination against other species with selectivity factors > 100; *(ii)* good sensitivity towards the desired analyte down to the nanomolar range; *(iii)* fast response within the millisecond scale time; *(iv)* long-term stability over 1-2 hours; *(v)* small size of around 10-50 µm to offer non invasive and non destructive close proximity to the site of release (single cells, organelles) and *(vi)* ease of handling.
We present an overview of the successes and challenges still faced in the detection of NO,$O_2^{\bullet-}$ and$ONOO^-$in biological media. We provide a full discussion on the electrochemical analyses of each of these species and we summarize the significant research contributions towards the development of sensors for individual and simultaneous detection of these species. We emphasize the importance of understanding the potential interferents in developing such sensors. We show that significant advances have been made with regards to detection of NO in biological media leading to the development of marketable NO sensors, though there is room for improvement in terms of interferences. A brief outlook into the future perspectives of the use of multi electrochemical array sensor for simultaneous detection of NO, $O_2^{\bullet-}$ and$ONOO^-$ is presented.

References

[1] Feelisch M., Stamler, J. S. (Eds) ***Methods in Nitric Oxide Research***, Wiley (Chichester, UK), 1996.
[2] Ignarro L. J., Buga G. M., Wood K. S., Byrns R. E, Chaudhuri G, ***Proc. Natl. Acad. Sci USA***84 (1987) 9265-9269.
[3]Hall C. N., Garthwaite J., ***Nitric Oxide*** 21 (2009) 92-103 and references cited therein.
[4] Bedioui F., Quinton D., Griveau S., Nyokong T., ***Phys. Chem. Chem. Phys***. 12 (2010) 9976-9988 and references cited therein.
[5] Griveau S., Bedioui F. ***Electroanalysis*** 25 (2013) 587-600 and ***Anal. Bioanal. Chem***. 405 (2013) 3475-3488.

Electrochemical impedance spectroscopy and constant phase elements for corrosion investigations

Yasser Ben Amor

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Electrochemical impedance spectroscopy (EIS) plays an important role in fundamental and applied electrochemistry and materials science [1]. EIS is a powerful technique for corrosion investigations. The interpretation of EIS results is usually done through the construction of equivalent electric circuits that simulate the system under investigation. This allows the extraction of physical parameters related to the electrochemical behavior that are not easily accessible by other techniques. The constant-phase element (CPE), which is purely a mathematical description, is often applied to represent impedance data, but it gives no insight into the physical processes that yield such a response. While CPE behavior is observed experimentally, its interpretation has been controversial for many years. However, if the CPE behavior can be considered to be evidence of frequency dispersion, its origin can be due to dispersion of the resistance, of capacitance, or both. This contribution may be also attributed to the distribution of physical properties in films, in direction normal to the electrode surface. A normal power-law distribution of local resistivity with a uniform dielectric constant was found to be consistent with the CPE [2]. An analytic expression of the impedance of the film, based on the power-law resistivity distribution, was found that relates CPE parameters to the physical properties of a film: This expression worked well for such diverse metallic metals and alloys [3-5]. The extension of the power-law model to anti-corrosion coatings is shown to yield insight into the distribution of resistivity and associated water uptake. Evaluation of mixing rules for conductivities and permittivity of two media (coating and electrolyte) showed that the linear combination provided results that were consistent with the observed impedance response.

References

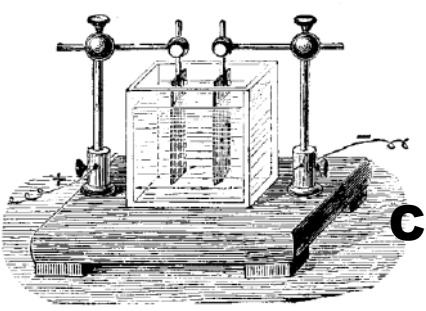
[1] E. Barsoukov and J. R. Macdonald, Impedance spectroscopy, Theory, Experiment, and Applications, 2nd Edition (John Wiley & Sons, New Jersey, 2005).

[2] B. Hirschorn, M.E. Orazem, B. Tribollet, V. Vivier, I. Frateur, M. Musiani, J. Electrochem. Soc. 157 (12) (2010) C452.

[3] M. Musiani, M.E. Orazem, N. Pébère, B. Tribollet, V. Vivier, J. Electrochem. Soc 158 (12) (2011) C424.

[4] B. Hirschorn, M.E. Orazem, B. Tribollet, V. Vivier, I. Frateur, M. Musiani, J. Electrochem. Soc. 157 (12) (2010) C458.

[5] Y. Ben Amor, E. Sutter, H. Takenouti, B. Tribollet, M. Boinet, R. Faure, J. Balencie, G. Durieu, Electrochimica Acta 131 (2014) 89.



Oral Communications' List

Communicatings' Names	Ref
D. Abdi and H. Chettah *Université Ferhat Abbas, Sétif-, Algeria* Investigation of the structural, morphological and optical characterization of nanostructured ZnO films obtained via chronoamperometry technique	**OC 1**
I. Abidli, N. Souissi and X. R. Novoa *IPEI, Tunisia* Corrosion inhibition of iron by the extract of Curcuma in acidic and chloride medium	**OC 2**
N. Frikha, E. Hmani, M. Bouazi and R. Abdelhedi *FSS, Tunisia* Recovery of hydroxytyrosol a high added value compound through *m*-tyrosol conversion by electro-Fenton process	**OC 3**
S. Bouachma, S. Messaci, A. Manseri, N. Nasrallah, M. Azzaz**,** M. Kechouane and N. Gabouze *Algeria* Deposition of Semiconductor-Oxides for CO_2 gas sensing	**OC 4**
A. Boulares, L. Dhouibi, P. Bercot and E. Rezrazi *ENIT***,** *Tunis, Tunisia* Electrochemical behavior of titanium oxyhydroxide/manganese oxide composite electrodeposited on a pure copper substrate	**OC 5**
S. Dhkili, S. Besbes-Hentati and E. Morallón *FSB , Tunisia* Chemical and Electrochemical synthesis of Conducting Piperazine -2.6-diéthylaniline Copolymer	**OC 6**
W. Ebdelly, S. Ben Hassana, X.R. Novoa and Y. Ben Amor *ISSTE, Borj Cedria, Tunisia* Inhibition of carbon steel corrosion in calcareous solution by plant extract	**OC 7**
M. Abidi, S. López-Bernabeu, F. Huerta, F. Montilla, S. Besbes-Hentati and E. Morallón *FSB, Bizerte, Tunisia* Electrochemical oxidative polymerization of 2-amino -4-tert-butylphenol and in situ spectroelectrochemical characterization	**OC 8**
M. Ghazouani, H. Akrout, S. Jellali and L. Bousselmi *CERTE, Techopark Borj Cedria***,** *Tunisia* Comparative study of oxidation/reduction on BDD cell and electrocoagulation for the treatment of dairy wastewater	**OC 9**
M. Gritli, H. Cheap-Charpentier, O. Horner, H. Perrot and Y. Ben amor *ISSTE, Borj Cedria, Tunisia* Inhibitory scaling effect of $Cu^{2+}$and Zn^{2+}cations in calcocarbonic synthetic waters	**OC 10**

Communicatings' Names	Ref
R. Kahlaoui, K. arbi, I. Sobrados, R. Jimenez, J. Sanz and R. Ternane *FSB, Bizerte, Tunisia* Relationships between structure and electrical conductivity of Nasicon-type materials $Li_{1\pm x}M_xTi_{2-x}(PO_4)_3$ (M=Nb, Sc and $0 \leq x \leq 0.5$)	**OC11**
H. Lahbib, H. Gerengi and Y. Ben Amor *ISSTE,Borj Cedria, Tunisia* Corrosion inhibition effect of dwarf palm (*Chamaerops humilis l.*) leaves extract for low carbon steel in 15% H_2SO_4	**OC12**
R. Mejri, S. Lanceros Mendez and S. Besbes-Hentati *FSB, Bizerte, Tunisia* From the synthesis of poly(vinylidene fluoride) 1-ethyl-3methylimidazolium bid (trifluoromethylsulfonuyl) imide film actuator to its electrodeposition on a platinum surface	**OC 13**
F. Moncer, A. Halder, Y. Sun, N. Adhoum and L. Monser *INSAT, Tunisia* Swimming imprinted micro-motors for highly selective''on-the-fly'' biosensing	**OC14**
R. Nihed, W. Tahri, J. Desbriéres and S. Besbes-Hentati *FSB, Bizerte, Tunisia* Improvement of chitosan solubility and **bactericidity** by synthesis of N-benzimidazole-O-acetyl-Chitosan and its electrodeposition	**OC15**
M. Saidi, A. Amrane and N. Bellakhal *FSB , Tunisia* Electrochemical oxidation of chlortetracycline antibiotic on a nickel foam electrode: biodegradability improvement	**OC 16**

Investigation of the structural, morphological and optical characterization of nanostructured ZnO films obtained via chronoamperometry technique.

D. Abdi and H. Chettah

Laboratoire d'énergétique et d'électrochimie du solide. Faculté de Technologie. U. F.A. Setif 1, 19000 Algérie.

A variety of ZnO nanostructures have been electrodeposited on fluorine doped tin oxide (FTO) using optimized mixed bath composition and chronoamperometry as electrochemical technique. The obtained deposits exhibit different structures and morphologies varying with the imposed potentials values. Their XRD patterns show hexagonal structure type Wurtzite, with a preferential orientation along the axis (002) and (101). SEMshows different dimension and sizes depending to the applied potentials values, their morphologies differ from compacted nanorods, nanoflowers and nanowires. The optical behaviour of the deposits varies between opacity and transparency and the higher transmittance of 75% was obtained for -1.2 V, Gap values evolution occurs arbitrarily. All deposits display important generated photocurrent under light irradiation which permits to use them in photovoltaic cell.

Keywords: ZnO films, Chronoamperometry,Photovoltaic cell.

Corrosion inhibition of iron by the extract of Curcuma in acidic and chloride medium

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[1]*Faculty of Sciences of Tunis, University of Tunis El-Manar, Tunis, Tunisia*
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[3]*ENCOMAT laboratory, School of Industrial Engineering, University of Vigo, Spain*

The effect of the aqueous extract of Curcuma and their main constituents involve phenols compounds, as iron corrosion inhibitor in 0.1 M HCl and 0.1 M NaCl solutions was investigated by EIS measurements. Electrochemical impedance spectroscopy (EIS) investigations were used for different concentrations of Curcuma extract. EIS measurements show an increase of the transfer resistance with increasing inhibitor concentration. The temperature and time of immersion effects on the corrosion behavior of iron without and with the extract of Curcuma were studied. The inhibition action of the extract was discussed in view of Langmuir adsorption isotherm.

Keywords: Iron, Barrier properties, Mechanical properties, EIS, Surface analysis.

Recovery of hydroxytyrosol a high added value compound through *m*-tyrosol conversion by electro-Fenton process

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The electrochemical oxidation of méta-tyrosol (*m*-Tyr) 2-(3-hydroxyphenyl) ethanol in aqueous solutions was realized in order to convert it into potentially high-added-value products, as well as hydroxytyrosol (HT). This reaction is studied by electro-Fenton (EF) process using a carbon fiber cloth as cathode and Pt anode. The evolution of the concentrations of *m*-Tyr and its oxidation products during electrolysis was performed by means of high performance liquid chromatography (HPLC).The influence of several operating parameters on electrochemical MT oxidation, such as applied current, initial *m*-Tyr concentration and nature of catalyst was investigated. Under the optimal obtained conditions ($[Fe^{3+}]$ = 5 10^{-4} $molL^{-1}$, I = 20 mA, [*m*-Tyr] = 12.5 $molL^{-1}$). The experimental data indicated that the *m*-Tyr disappearance kinetics follows a pseudo first order. The maximum HT concentration, increases with initial *m*-Tyr concentration and decreasing the applied current. The predominance of HT was interpreted by its stabilization by complexation with iron ions. Finally, a mechanistic pathway for the *m*-Tyr oxidation by EF process was proposed.

Keywords*:* *m*-tyrosol, Hydroxytyrosol, Electro-Fenton, Iron complex, Carbon fiber.

Deposition of Semiconductor-Oxides for CO_2 gas sensing

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Because of its high reactivity and high specific surface (200-600 m^2/cm^3), porous silicon has been shown to be an interesting base material for gas sensing application. However, the electrical response of the PS layer can lead to remarkable differences depending on the oxidation of the PS surface [1]. Copper oxides have attracted attention because of their potential applications as chemical sensors and as the active components of various electrical and optical devices. Thin films of copper oxides for CO_2 sensor applications with the best sensitivity and selectivity have been prepared by several authors; however, the sensors work generally at sensing temperature of about 200°C and the sensing mechanism is not yet fully understood [2].

In the present work, a gas sensing device based on Copper oxide (CuO-Cu_2O)/Porous Si (PS)/Si structure subjected to carbon dioxide gas (CO_2) has fabricated and studied. The porous layer was prepared electrochemically from n-Si in aqueous HF. The porous samples were coated with copper oxides electrodeposited at about -0.5 V in ($CuSO_4$ + tartaric acid (L+)) at a pH 11. The structural and morphological properties of the copper films were investigated by means of X-ray diffraction (XRD) and scanning electron micrograph (SEM), respectively. Sensitivity, response time of the fabricated device to CO_2 gas exposure has been also investigated. The obtained results show a porous morphology of the copper oxides deposited. The XRD patterns indicate the presence of both phases CuO and Cu_2O.

Finally, it was found that junction realized from copper oxide thin films showed a rectifying behavior and that the device response is modified by the CO_2 gas on the CuO-Cu_2O/PS surface at ambient temperature. A High sensitivity and rapid response and recovery times are observed.

Keywords*:* Copper oxide thin films, Porous Silicon, Electrochemical deposition, CO_2 gas sensor.

References:

[1] R. PalithaWijesundera, Book Solar cells, Thin-film Technologies, 2011.
[2] S.Sindhu, Electrochemical synthesis of p-type copper oxides, 2016.

Electrochemical behavior of titanium oxyhydroxide/manganese oxide composite electrodeposited on a pure copper substrate

A. Boulares[1,3], L. Dhouibi[1,2], P. Bercot[3] and E. Rezrazi[3]

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[2]*Université de Tunis, IPEIT, 1089 Montfleury, Tunis, Tunisia*
[3]*Université Bourgogne Franche-Comté, Institut UTINAM, CNRS UMR 6213, Besançon, France*

Transition metal oxides have known for many years an industrial interest due to their high electrical conductivity, high optical transmission and good chemical resistance, which explains their frequent use in optical, electronic and medical fields. One of the very interesting properties of metal oxides which has not been much studied is their electropassivity in oxidation and their stability in chloride media when used as coatings on some metallic substrates.
The deposition of thin layers of oxides on metallic substrate is quite delicate due to their pulverulent and non-adherent properties. The aim of this study was to elaborate by simple methods, a mixed composite based on titanium oxyhydroxide/manganese oxide on pure copper substrate and to study its electrochemical behavior in chloride medium.
The elaboration was made through a cathodic electrodeposition by local pH variations for depositing titanium oxyhydroxide and a cathodic reduction for depositing manganese oxide. The structural and morphological techniques (SEM, EDS, XRD, GD-OES), showed that the composite has a nodular structure with a co-distribution of titanium and manganese on copper surface.
The electrochemical behavior of titanium oxyhydroxide/manganese oxide composite electrodeposited on a pure copper substrate in 3% NaCl medium was studied using stationary and transient electrochemical techniques: Cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS).
Copper substrate reacts as an antioxidant by preventing the composite oxidation even at very anodic potentials and contributes, through its passive behavior, to the improvement of the stability of the composite over time in chloride medium.

Keywords : Plating, Copper, Titanium oxyhydroxide, Manganese oxide, Composite, Antioxidant.

Chemical and Electrochemical synthesis of Conducting Piperazine - 2.6-diéthylaniline Copolymer

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Polyaniline ranks among important conducting polymers with highly promising features for different applications. However, it has been observed that some of its properties still need further improvement such as their insolubility in common solvents and their electroactivity only at low pH [1]. Several authors have investigated the synthesis of aniline copolymers and substituted aniline with other molecules such as, aminobenzenesulfonic acids [2]. In this work, we describe the synthesis and characterization of poly(piperazine-co-2,6-diéthylaniline), via oxidative chemical polymerization in acidic medium, using ammonium peroxide sulfate, at 0°C, which was also synthesized by electrochemical method. The copolymer was characterized by spectral and physical techniques such as HNMR, UV–Visible, FT-IR, andthermo gravimetric analysis. Morphological study reveals that the neutral copolymer forms into spongy and porous structure. The solubility of the copolymer in dimethylsulfoxide and dimethylformamide increased to a certain extent.

Keywords: Conductive polymers, Piperazine -2,6-diéthylaniline copolymer , Cyclic voltammetry, Electropolymerization.

Reference

[1] C.M.A. Brett, F. Oliveira Brett, J. L. C. Pereira, C. Rebelo, J. Appl. Electrochem. 23 (1993) 332.
[2] C. Sanchis, H. J. Salavagione, J. Arias-Pardilla, E. Morallon, Electrochim. Acta 52 (2007) 2978.

Inhibition of carbon steel corrosion in calcareous solution by plant extract

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The effect of aqueous extract of plant against corrosion of carbon steel in synthetic calcareous underground Tunisian water has been examined by various analytical and electrochemical techniques [1-3]. The electrochemical results suggest a decrease in the corrosion current; therefore, an increase in the polarization resistance in the presence of aqueous extract.
The highest inhibition efficiency can berelated to the large amount of phenolic compounds in this plant. Furthermore, SEM observations and FT-IR analyses corroborate the electrochemical results.

Keywords: Corrosion, Inhibition, Carbon steel, Plant extract, EIS.

References:

[1] Y. Ben Amor, L. Bousselmi, H. Takenouti, E. Triki, Corrosion Engineering, Science and Technology 40 (2005) 129-136.
[2] L. Bousselmi, C. Fiaud, B. Tribollet, E. Triki, orros.Sci.39 (1997) 1711-1724.
[3] M. S. Al-Otaibi, A. M. Al-Mayouf, M. Khan, A. A. Mousa, S. A. Al-Mazroa e H. Z. Alkhathlan, Arabian Journal of Chemistry, 7 (2014) 340-346.

Electrochemical oxidative polymerization of 2-amino -4-tert-butylphenol and in situ spectroelectrochemical characterization

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The electropolymerization of o-aminophenol have been the subject of several investigations, due to its interesting properties owing to the presence of electroactif amino and hydroxyl group. The synthesized poly(o-aminophenol) in acidic medium leads to a conducting material in which the phenoxazine units was the ladder structure [1,2].
Poly(2-amino-4-tert-butylphenol), poly(2A-4TBP) (Fig.1), was synthesized from 2A-4TBP (Fig.2) monomer in aqueous solution using electrochemical oxidation procedure. In Situ Spectroelectrochemical characterization techniques were employed to gain informations on the chemical structure and the redox behavior of the obtained material. It was found that the synthesized product shows the presence of phenoxazine rings that, usually, constitute the basic structure of polymers derived from o-aminophenol. In addition, it has been concluded the occurrence of N-N couplings, which are favored by the presence of the voluminous tert-butyl substituent [3].

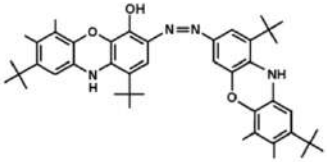

Fig.1: Poly(2-amino-4-tert-butylphenol):

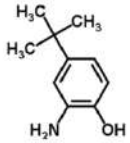

Fig.2: 2-amino-4-tert-butylphenol(2A-4TBP)

Keywords: electrochemical polymerization, in situ FTIR, 2-amino-4-tert-butylphenol (2A-4TBP)

References:

[1] H.J. Salavagione, J. Arias, P. Garcés, E. Morallón, C. Barbero, J.L. Vázquez, Spectroelectrochemical study of the oxidation of aminophenols on platinum electrode in acid medium, J. Electroanal. Chem. 565 (2004) 375–383.
[2] A.-H.A. Shah, R. Holze, Spectroelectrochemistry of two-layered composites of polyaniline and poly(o-aminophenol), Electrochim. Acta 53 (2008) 4642– 4653.
[3] M. Abidi[a,b], S. López-Bernabeu[b], F. Huerta[c], F. Montilla[b], S. Besbes-Hentati[a], E. Morallón[b],The chemical and electrochemical oxidative polymerization of 2-amino -4-tert-butylphenol,Electrochimica Acta 212 (2016) 958–965.

Comparative study of oxidation/reduction on BDD cell and electrocoagulation for the treatment of dairy wastewater

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Dairy industries generate large amount of wastewater with a complex composition and wide ranges of pollutants. These effluents are characterized by a high load of organic pollutants essentially carbohydrates, proteins and fats, in addition to nutrients mainly nitrogen and phosphorus. Conventional processes used for the treatment of those wastewaters remain ineffective in the case of persistent and recalcitrant pollutants, which pass through treatment plants without any modification [1]. Consequently, the treated effluents do not always meet the legal limits for waste discharge, which has negative socio-economic impacts on the health and life quality of the population. In this context, the aim of this work is to test a new electrochemical approach in order to achieve a treated dairy wastewater under the national standards for wastewater discharge and reuse and optimize the energy cost.

An investigation of the efficiency of two electrochemical methods (electro-oxidation/electro-reduction (EOR) on boron doped diamond (BDD) electrodes and electrocoagulation (EC) on mild steel electrodes [2,3]) was establish. The raw wastewater was collected from a dairy Tunisian industry.

Results show that, the EOR with bipolar configuration BDD electrodes was the most effective process in term of removal rate of COD, nitrate, ammonium/ammonia. The electric energy consumption (EEC) was about 0.97 kWh (g DCO)$^{-1}$ which is considered as relatively high. However, the use of EC led to treated wastewater with lower quality regarding EOR process. While using EC process contributes to a 20 times decay of EEC (0.17 kWh (g DCO)$^{-1}$). The two methods led to a treated wastewater with a quality under national standards of discharge into natural media and can be reused in the irrigation issue when using EOR process.

Keywords: Wastewater,Electrooxydation/reduction, Boron Doped Diamond, Electrocoagulation, Mild Steel Electrodes.

References:

[1] M. Huebsch, B. Horan, P. Blum, K.G. Richards, J. Grant, O. Fenton, Agric. Ecosyst. Environ. 179 (2013) 187–199.
[2] M. Ghazouani, H. Akrout, L. Bousselmi, Environ. Sci. Pollut. Res. (2017).
[3] M. Ghazouani, H. Akrout, S. Jellali, F. Lapicque, L. Bousselmi, (2018) 125–127.

Inhibitory scaling effect of $Cu^{2+}$and Zn^{2+}cations in calcocarbonic synthetic waters

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Scale deposits are often observed in different industrial processes and domestic installations. Scaling plays a very important role in diverse fields of industry and, consequently, in economics. The influence of metal cations on the precipitation of calcium carbonate has always attracted the attention of researchers [1]. The techniques adopted to examine the effect of these cations are generally based on chemical and electrochemical scaling tests [2].
This work describes the influence of copper and zinc cations on the precipitation of $CaCO_3$.The anti-scaling effect of these ions, in synthetic waters, was studied by using fast controlled precipitation (FCP) method [3] and electrochemical quartz crystal microbalance (EQCM).These measurements allow to following the process of germination and growth of calcium carbonate in solution or on a metallic surface. EQCM is a high-precision instrument for measuring mass variation on the active gold surface [4]. This technique, based on QCM with a pre-scaled detection surface (SQCM method), was used to track the scale deposition rate. The results obtained show that Cu^{2+} and Zn^{2+} ions are very efficient scale inhibitors. Indeed, with a hardness of 50° F, the optimal dose is 4 mg L^{-1} for Zn^{2+} and 5 mg L^{-1} for Cu^{2+}. These results are confirmed by SQCM method.
Both scanning electron microscopy (SEM) and X-ray diffraction (XRD) analysis showed that these ions may affect the crystalline morphology of $CaCO_3$.

Keywords: Scaling inhibitor, copper, zinc, Fast Controlled Precipitation, Scaling Quartz crystal microbalance.

References:

[1] Wen-jun, L; Hui,F;Lédion, J; Xing-wu, W, *Ionics*, **2008**, 14, 449-454.
[2] Ghizellaoui, S. Lédion, J ; Ghizellaoui, S; Chibani, A, *Desalination*,**2004**, 166, 315-327.
[3] Gauthier, G ; Chao, Y; Horner, O ; Alos-Ramos, O ; Hui F., Lédion, J ; Perrot, H,*Desalination*, **2012**, 299, 89-95.
[4] Dimitri, P; Cheap-Charpentier, H; Horner, O; Perrot, H, *water Process Engineering*, **2015**, 7, 11-20.

Relationships between structure and electrical conductivity of Nasicon-type materials $Li_{1\pm x}M_xTi_{2-x}(PO_4)_3$ (M=Nb, Sc and $0 \leq x \leq 0.5$)

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Titanium-based NASICON materials $Li_{1-x}Nb_xTi_{2-x}(PO_4)_3$ and $Li_{1+x}Sc_xTi_{2-x}(PO_4)_3$ have been prepared by the solid-state reaction method and characterized using X-ray diffraction (XRD), IR and Raman spectroscopies and Impedance Spectroscopy (IS) techniques. The X-ray patterns refinements based on the Le Bail model confirmed the formation of secondary phases besides the rhombohedral NASICON-type structure (space group $R\bar{3}c$).
The addition of Nb^{5+} pentavalent ions, even in small amount, gives rise to that the Li^+ ions occupy only the M1 sites in the NASICON structure. While, the partial substitution of Ti^{4+} tetravalent ions by Sc^{3+} trivalent ions, forces the Li^+ ions to occupy a new M3 site.
The impedance spectroscopy measurements allowed us to relate the electrical properties to the structural data. The variation of the ionic conductivity and the activation energy was correlated to the number of charge carriers into the NASICON framework. At room temperature, the highest conductivity of 2.5 x 10^{-3} $S.cm^{-1}$ and the lowest activation energy of 0.25 eV were found in $Li_{1.2}Sc_{0.2}Ti_{1.8}(PO_4)_3$ NASICON. These values are comparable with those found in the best ionic conductors reported to date.

Keywords: NASICON, Impedance Spectroscopy, Conductivity, Activation Energy.

Corrosion inhibition effect of dwarf palm (*Chamaerops humilis l.*) leaves extract for low carbon steel in 15% H_2SO_4

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Corrosion inhibitors are substances that are added in small amounts to the environment to prevent metal dissolution, through the formation of a protective film [1]. Corrosion of Low Carbon Steel in a sulfuric acid medium is often observed in many industrial sectors [2]. Apparently, corrosion cannot be avoided, but its severity can be reduced to a lower magnitude.
St37 steel is known for its excellent strength and is preferred to be used where high mechanical strength is required, such as in ship and bridge construction, riveting, bolting, etc. [3]. On the other hand, mineral acids, particularly sulfuric acids in the concentration range of 15–28%, are often used for industrial metal scale removal and cleaning, as well as other practices such as acid descaling and oil well acidizing [4].
In this project, the inhibitory behaviour of *Dwarf Palm* leaves extract for St37 steel in 15% H_2SO_4 solution has been studied by using potentiodynamic polarization (PDP), electrochemical impedance spectroscopy (EIS), and dynamic electrochemical impedance spectroscopy (DEIS). Electrochemical investigations are completed via a surface morphological examination, which uses scanning electron microscopy (SEM). The data obtained from all methods present the same tendencies.PDP results and show that *Dwarf palm (Chamaeropshumilis L.)* leaves extract acts as a good mixed type inhibitor. The dissolution rate decreased with the increase of the *Dwarf Palm* leaves extract concentration.
Keywords: St37 steel, Corrosion inhibition,*Chamaerops humilis L*, EIS, DEIS.

References:

[1] I. B. Obot, N.O. Obi Egbedi, , Corros Sci, Vol. 52,2010.
[2] V. Eswaramoorthi, S. Jagadeesan, S. Palanisamy, P. Kandhasamy, S. Chitra, J. Adhes. Sci Technol., vol. 30, 2016
[3] Bebon, H (2011). St37 steel plate. www.steel-plate-sheet.com/ Steel-plate/D/N/St372.html. Accessed 2nd July 2016
[4] Nataraja SE, Venkatesha TV, Manjunat K, Poojary B, PavithraMK, Tandon HC, Corros Sci, Vol. 53, 2011.

From the synthesis of poly(vinylidene fluoride) 1-ethyl-3methylimidazolium bid (trifluoromethylsulfonuyl) imide film actuator to its electrodeposition on a platinum surface

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Actuator based on poly(vinylidene fluoride) (PVDF) and ionic liquid (IL) has been prepared by solvent casting with 40 % of 1-ethyl-3methylimidazolium bid (trifluoromethylsulfonuyl) imide. A good miscibility has been obtained and has been assigned to the interaction between the CF_2 groups of the PVDF chains and the imidazolium ring of IL. The addition of IL leads to the crystallization of PVDF in the β-phase and decrease significantly the degree of crystallinity and the elastic modulus. The bending movement of the IL/ PVDF composite is correlated to their degree of crystallinity, mechanical properties and ionic conductivity value [1]. By means of cyclic voltammetry study in acetonitrile solution, we show that our blend undergoes an irreversible oxidation step and a consecutive electrodeposition step at a platinum disk.

Keywords: PVDF, Ionic liquid, Actuators, Bending, Cyclic Voltammetry

References:

[1] R. Mejri et al, European Polymer Journal 85 (2016) 445-451

Swimming imprinted micro-motors for highly selective ‘‘on-the-fly’’ biosensing

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Mimicking natural biological process was considered as the most fascinating challenge in Nanomedicine due to obvious benefits especially in the field of biosensing and drug delivery. Since current cancer treatments like radiation therapy and chemotherapy often end up destroying more healthy cells than cancerous ones, developing artificial microscale medical containers seems to be a very promising solution [1]. Those imprinted small microengines could propel directly to the infected area in the body for rapid and highly selective biosensing which is achieved by catalytic motion [2]. In this context, chemically propelled tubular micromotors driven by catalytic fuel source was investigated based on the template electrochemical deposition method for in-vivo application. The SEM images have shown 13 µm length tubular structures proving their microscale design. The high-speed of microjets (460 nm/s) highlights the promising applicability of these tiny machines in the human body for a very fast screening test.

Keywords: Electrochemical deposition, Micro-motors,Tubular structures, Biosensing.

References :

1. O. Akhavan*et al.*, Nano Lett, 2016, 16, 5619-5630.
2. M. Medina-Sanchez *et al.*, Nature, 2017, 545, 406-408.

Improvement of chitosan solubility and *bactericidity* by synthesis of N-benzimidazole-O-acetyl-Chitosan and its electrodeposition

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2Laboratoire de Biochimie et de Biologie moléculaire, Faculté des Sciences de Bizerte, Université de Carthage, Tunisie.
3Université de Pau et des Pays de l'Adour, Institut des Sciences analytiques et de Physico-Chimie pour l'Environnement et les Matériaux, Pau, France

Chitosan solubility and its antibacterial activity have been improved first of all with a chemical synthesis of N-benzimidazole-O-acetyl-chitosan in acetic medium and foremost through a potentiodynamic electrodeposition of this derivative. An association of one benzimidazole and three acetyl moieties per two units of the biopolymer chain was evidenced by FTIR and 1H NMR and pH-metric titration. Cyclic voltammetry study of the modified polymer in acetonitrile solution reveals its anodic oxidation at a platinum disk and a progressive growing of a thin film, through the cycling of potential. An enhancement of the solubility of the biopolymer as well as its antibacterial activity against Salmonella typhimurium, Escherichia coli, Staphylococcus aureus and Pseudomoenas aeruginosa bacteria have been observed with these chemical and electrochemical modifications [1].

Keywords: N-Benzimidazole-O-acetyl-chitosan; Solubility; Cyclic voltammetry; Electrodeposition; Antibacterial activity.

References

[1] N. Rahmouni et al., International journal of Biological macromolecules, 113 (2018) 623-630.

Electrochemical oxidation of chlortetracycline antibiotic on a nickel foam electrode: biodegradability improvement

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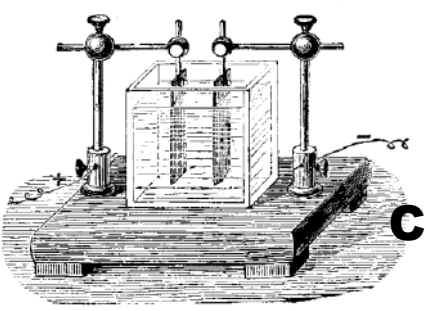
This project deals with the electrochemical oxidation coupled with biological treatment of biorecalcitrant antibiotic: chlortetracycline (CTC). This organochlorine compound releases from pharmaceutical industrial waste into the environmental water and usually causes suspected undesirable effects in aquatic organisms. The pre-treatment was performed in a home-made flow cell involving nickel foam as a working electrode at potential of 0.55 V/saturated calomel electrode (SCE). The electrolysis through the percolation cell led to a more than 99% conversion yield of chlortetracycline in oxidation in alkaline conditions. The evolution of the concentration during treatment was followed up by Ultra Performance Liquid Chromatography (UPLC). Cyclic voltammetry with a nickel electrode revealed a significant electrochemical activity of chlortetracycline. Total Organic Carbon (TOC) analyses of the electrolyzed solution revealed that the level of mineralization remained low, underlying the interest of a combined electrochemical and biological treatment. The biodegradability, based on the BOD_5 on COD ratio, was studied at the oxidation potential of 0.55 V/ SCE. The electrolyzed solutions were biodegradable. Moreover, a simultaneous generation of chlorides was observed and intermediates were identified and monitored during 4h of electrolysis.

Keywords: Chlortetracycline, biodegradability, electro-oxidation pretreatment, percolation cell.



Poster Communications' List

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N. Aliouane, N. Ait Ahmed, H. Hammache, O. Duval *Université de Bejaia, Algérie* Synthesis of phosphonate derivatives and their anticorrosive effect on carbon steel in 3%NaCl solution	**PC3**
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Communicatings' Names	Ref
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M. Ben garali, M. kahlaoui and C. Chaabane *FSB, Bizerte, Tunisia* Electrochemical and structural study of new cathode materials for SOFC	**PC12**
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F. Masmoudi, I. Jdidi and M. Masmoudi *FSS, Tunisia* Evaluation of corrosion protection of nanostructured carbon black filled polystyrene-block-poly(ethylene-ran-butylene)-block-polystyrene triblock copolymer coatings on copper during exposure to a quiescent 3% NaCl solution	**PC32**
F. Moncer, Y. Sun, N. Adhoumand L. Monser *INSAT, Tunisia* Electrochemical imprinted nano-platform for highly sensitive detection of a Chem-biomarker in biological fluids	**PC33**
M. Jaouadi and H. Hamzaoui *Technologic Park of BorjCedria Tunisia.* Valorization of olive mill solid waste: removal of copper from waste water	**PC34**
S. Mosbah, L. Benmekhbi, J. RaultBerthelot and L. Bencharif *Université Constantine1, Algérie.* Comparative study of Arylene-Cyanovinylene isomers electronic properties and their electrogenerated polymers	**PC35**
S. Mosbah, B. Anak and L. Bencharif *Université Constantine1, Algérie.* Synthesis of New Materials for Use As Organic Active Layers Characterization of Z (2, 3-diAryl) Acrylonitrile by Cyclic Voltammetry and Impedance Spectroscopy	**PC36**
S. Mouzali, D. Haffar and L. Bouzidi *Université Ferhat Abbas Sétif. Algérie.* Evaluation of inhibition of corrosion two schiffbases on Carbon Steel in 1 M HCl	**PC37**
I. Naomiand N.Bellekhal *INSAT, Tunisia* Modified carbon felts as efficient cathode for electro-Fenton process	**PC38**
M. Naffati, S. Zanna, P.Cornette, D. Costa, P. Marcus, M.M. Abderrabba and S. Somrani *IPEIT, Tunisia* Phenyl phosphate as Ni-Cr alloy dissolution inhibitor: Experimental investigation	**PC39**

Communicatings' Names	Ref
F. Nouri, M. Trabelsi-Ayadi and R. Ternane *FSB, Bizerte, Tunisia* Electrical conductivity of $Ca_{10}(PO_4)_6F_2$ as single crystals and powders	**PC40**
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N. Sedira,N.Bourenane and Y. Hamlaoui *Université Souk-Ahras. Algeria* Electrochimical behavior of mild steel in different corrosive media: corrosionmonitoring	**PC42**
L. Toukaland S. Keraghel *Université Sétif-1, Algeria* Inhibitory effectiveness of some benzimidazole towards mild steel corrosion in HCl solution	**PC43**
R. Yahyaoui and K. Nahdi *FSB, Bizerte, Tunisia* Investigation of the electrical properties of $Mg_6Al_2(OH)_{16}CO_3.4H_2O$ by complex impedance spectroscopy technique	**PC44**
D.Zouied, O. Chikha, E. Zouaouiand J. KalthoumCherif *Skikda, Algeria* Antioxidant activity of arbutus plant extract and their corrosion inhibiting properties of carbon steel in a 3% NaCl solution	**PC45**
R. Zrelli-Annabi, F. Chehimi-Moumen, D. Ben Hassen-Chehimi and M. Trabelsi-Ayadi *FSB, Tunisia* Synthesis, characterization, optical and electrical properties of $HLnP_2O_7{\cdot}xH_2O{\cdot}yNH_3$ and $Gd_2P_4O_{13}$ (Ln = Gd, Ho)	**PC46**
R. Guedouar, M.Abidi, N. Derbel, M. MhiriKammounand S. Besbes-Hentati *FSB, Tunisia* Novel electrochemical route to Benzimidazole dimer as deposit on platinum surface	**PC47**
I. Ameur, S.Dkhil, S. Besbes-Hentati and S. Abid *FSB, Tunisia* Joint investigations of the electrochemical behavior and antibacterial activity of a Cadmium Coordination Polymer Based on Phosphate Clusters	**PC48**

Communicatings' Names	Ref
S. Ellouze, S. Kessemtini, D. Clematis, G. Cerisola, M. Panizza , S. Chaâbane Elaoud *FSS, Sfax* Application of experimental design to the electro-Fenton treatment of Bismark Brown Y	**PC49**
B. Bouzayani, J. Meijide , M. Pazos, M. A. Sanroman, S. Chaâbane Elaoud *FSS, Sfax* Complete removal of poly R-478 synthetic dye from water using new electro-fenton oxidation catalyzed by pyrite as heterogeneous catalyst	**PC50**

Correlation between the electronic structure and the inhibition efficiency of Curcuma extract for iron corrosion in acidic and chloride media

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The inhibiting effect of Curcuma extract was studied for iron corrosion in acidic medium and aqueous chloride medium using quantum chemical calculations. Analysis of the extract composition using GC/MS chromatography showed the presence of various compounds including three main molecules which were Curcuma, Curcuma II and Curcuma III. The theoretical investigation was performed with DFT methods at the B3LYP/6-311G (d) and B3LYP/3-21G basis set. The results allowed identifying the optimal geometries, the vibration frequencies, orbital borders and morphologies that the dipole moment (μ), the energy of the highest occupied molecular orbital (E_{HOMO}) and the energy of the lowest unoccupied molecular orbital (E_{LUMO}). In addition, the electron fraction transferred molecules (ΔN) was determined in order to understand the interaction-extracted surface. Thus, the index calculations Fukui (f-, f +) has been made in order to illustrate the mechanism of inhibition of this extract on iron surface. Satisfactory theoretical correlation was observed by a proposal of a metallic surface interaction mechanism of the extract.

Keywords: Green inhibitor, DFT calculations, Fukui indices, E_{HOMO}, E_{LUMO}, Inhibition mechanism

Electrocatalytic oxidation of ascorbic acid using a ZnO thin films modified glassy carbon electrode

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In the present work, ZnO nanostructures grown electrochemically on glassy carbon electrode (GCE) were used as electrochemical sensor. Surface morphology, composition and crystal structure of the as-deposited films were first studied by scanning electron microscopy, energy dispersive X-ray spectroscopy and X-ray diffraction. A highly oriented crystalline ZnO deposit made by a dense array of hexagonal nanowires perpendicular to the substrate was easily obtained without any additives. This ZnO/GCE electrode exhibited excellent electrocatalytic properties towards acid ascorbic oxidation (AA) compared with bare GCE, due to the simultaneous increases in surface area and kinetic parameters. It has been found that under optimum pH condition (pH 6.8) in 0.1 M phosphate buffer solution, the peak potential of AA oxidation was shifted from 0.55V on bare GCE to 0.1V on ZnO/GCE with higher current responses. This research raises the possibility of using ZnO as a promising anodic material.

Keywords: ZnO electrodeposition, Electrocatalysis, Electrochemical sensor, Ascorbic acid oxidation

Synthesis of phosphonate derivatives and their anticorrosive effect on carbon steel in 3%NaCl solution

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A new phosphonic acid derivativenamely{ethylene bis [(2-hydroxy-5,1,3-phenylene) bis methylene]} tetra phosphonic acid (ETPA)was synthesized and characterized by ^{1}H NMR, ^{13}C NMR; ^{31}P NMR and MS spectroscopic methods. Its inhibitive action on the corrosion of carbon steel in 3% NaCl solution at 298 K has been studied. Weight loss measurements, potentiodynamic polarization and impedance spectroscopy (EIS) methods have been used. The inhibition efficiency increases with the concentration of ETPA to attain 95 % at 10^{-3} M. A good agreement between gravimetric, potentiodynamic and impedance spectroscopy (EIS) has been observed. Polarization curves showed their behaviors as mixed-type inhibitor. EIS spectra exhibit one capacitive loop and confirm the inhibitive ability surface analysis was carried out to establish the mechanism of corrosion inhibition of carbon steel in 3%NaCl solution.

Keywords: Synthesis, Phosphonate, Corrosion, Inhibition, Carbon steel, EIS.

Electrochemical reduction of iodobenzene by copper(I) Schiff base electrogenerated at vitreous carbon cathode

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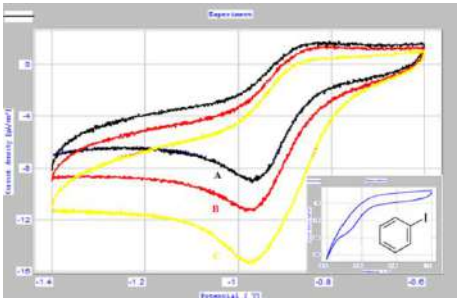
Considerable work has been reported concerning the structures, properties, and reactions of metal Schiff bases complexes. Although not as extensively investigated as its cobalt and nickel analogues [1-3], copper(II) complex of a Schiff base. has still received considerable attention. A number of workers have studied the chemical reduction of various compounds with copper Schiff base as a catalyst [4,5]. The Schiff base transition metal complexes are attractive reduction catalysts because of their cheap, easy synthesis and their chemical and thermal stability [6].

This report describe the electrochemical behavior of copper complex namely: bis{(p methoxybenzyl)[(2-oxo-1H-benzo-1-ylidene)methyl]aminato}copper(II), at glassy carbon cathode in DMF containing 0.1 M Et_4NBF_4 salt has been investigated by cyclic voltammetry. The electrocatalytic properties of this complex were examined in the electroreduction reaction of iodobenzene.Finally, we present the mechanism for electroreduction of iodobenzene proposed by P.C. Gach et al [7].



Cyclic voltammograms of 1 mM solution of Cu(II)-2L complex in DMF containing 0.1 M Et_4NBF_4 and different concentrations of iodobenzene at 100 mV s^{-1}: (A) without IB; (B) 4 mM IB; (C) 8 mM IB. The insetshows the electroreduction of Iodobenzene.

Keywords: Bidentate Schiff base copper(II) complex, Electrochemical behavior, Cyclic Voltammetry, Catalytic reduction.

References

[1] C. Ji, D. G. Peters, J. A. Karty, J. P. Reilly, M.S. Mubarak, J. Electroanalyt. Chem. **516**, 50–58 (2001).
[2] W. Philipp. Raess, S. Mohammad. Mubarak, A. Michael. Ischay, P. Matthew. Foley, B. Theodore. Jennermann, Krishnan Raghavachari, G. Dennis. Peters, J. of Electroanalyt Chem. **603**, 124–134 (2007).
[3] A. Ourari, C. Zoubeidi, W. Derafa, S. Bouacida, H. Merazig, E. Morallon, Res. Chem. Intermed. **43**, 3163–3182 (2017).
[4] J. Michael. Samide, G. Dennis. Peters, J. Electroanalyt. Chem. **443**, 95–102 (1998).
[5] A.Ourari, B. Ketfi, S.I. R. Malha , A. Amine, J.Electroanalyt. Chem.,**797**, 31–36 (2017).
[6] A. Ourari, W. Derafa, D. Aggoun., RSC Adv., **5**, 82894–82905 (2015)
[7] P.C. Gach, J. A. Karty, D. G. Peters, J. Electroanal. Chem., **612**, 22–28 (2008).

Aniline electropolymerization in basic hydroorganic solutions

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Synthesis of PANI is carried out in various neutral and acidic electrolytes. Limited littrature reported such synthesis in basic medium although the materials elaborated have interesting properties.
The present study aimed the electrochemical polyaniline production on metal electrodes and in hydroorganic baths. The quantum chemical calculations were undertaken for substrate deposition substrate choice. Electrochemical stationary techniques were used to evaluate the effects of the aniline and the hydroxide concentrations ([ANI] and [OH-]) on the experimental responses considered.
Various materials were considered when selecting the electrochemical deposition substrate. Based on the electronegativity χ, platinum was concluded as the most monomer oxidation promoter.
The electrochemical results showed that a polyaniline layer covered the substrate surface until only a few sites remain active when varying the scan rate from 1 mV s-1 to 2.5 mV s-1 and above 5 mV s-1. Furthermore, monomer and hydroxide ions diffusion ([ANI]> 0.4 mol L-1; 0.2mol L-1≤ [OH-] ≤0.025 molL-1) controled the electrochemical deposition of the polymer through its sites.

Keywords: PANI, Electropolymerization, Quantum chemical calculations, [ANI], [OH^-].

The relevance of electro-Fenton process for the biodegradability improvement of Enoxacin solutions

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Electrochemical Advanced oxidation processes (EAOPs) present a great alternative for the treatment of water polluted by toxic and persistent compounds. However, the mineralization of such molecules by EAOPs remains expensive and time consuming. To overcome these drawbacks, the present study examined the coupling of an EAOP (the electro-Fenton process) with a conventional biological treatment, consisting on an activated sludge culture, to treat Enoxacin, an antibiotic belonging to the family of Fluoroquinolones. The Enoxacin exists in some industrial livestock manure at a content of mg $L^{-1}$and it is poorly degraded by treatment plants and water purification. The presence of this antibiotic in the water, even at trace levels, causes disturbances in the aquatic ecosystem. Therefore, the aim of this study is to assess the relevance of the electro-Fenton process as a pre-treatment for solving the problem of Enoxacin wastewater pollution, prior to a conventional biological treatment.
Initially, the work was devoted to the monitoring of the mineralization and the biodegradability improvement of Enoxacin during its electrolysis, in optimal operating conditions. A degradation mechanism was also suggested for the antibiotic based on LC-MS/MS analyses during the electrochemical treatment. A pre-treatment duration was fixed according to the found results and only 180 min of treatment by the electro-Fenton process were needed to improve the biodegradability of the target molecule.

Keywords: Enoxacin, EAOP, Electro-Fenton, Mineralization, Biodégradability, Degradation mechanism.

Visible photocatalytic degradation of 4-Nitrophenol using WO_3-TiO_2-modified montmorillonites

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Tungsten oxide with different amounts are associated with TiO_2 modified montmorillonites to prepare active photocatalysts in visible. The obtained materials are evaluated by the visible photocatalytic degradation of 4-nitrophenol in water, since it is a recalcitrant organic pollutant. To understand the relationship between the prepared photocatalysts structure and performance, they are characterized by XRD, FTIR, SEM/EDX, ICP/OES, XPS, specific surface area and porosity measurements.

Meso-microporous materials are obtained with high stability, but the WO_3 addition decreases the photocatalysts specific surface area. In addition, characteristic XRD peaks of WO_3 phase are detected and their intensities increase with the added amount of WO_3. ICP chemical analysis shows that measured tungsten amounts are in accordance with those added.

The association between WO_3 and TiO_2 modified montmorillonites improve significantly the performance of different prepared photocatalysts in visible. 5% is the optimum rate of WO_3 added.

Keywords: TiO_2 modified montmorillonites, Photocatalysts, Visible, WO_3.

Ionic conductivity of mixed sulfate $Na_2M^{II}(SO_4)_2.4H_2O$ (M^{II}: Mg, Ni and Co) investigated by complex impedance spectroscopy technique

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In recent years, great interest has been brought to the study of ionic conductivity of materials, to be used as solid electrolytes.

In the framework of the research of new sulfates ionic conductors, we present in this work the results of the investigation of the electrical conduction properties of three anhydrous double salts with general chemical formula $Na_2M^{II}(SO_4)_2$. (M^{II}: Mg, Ni and Co).

The studied samples were prepared in a pellet form, with 12 mm of diameter, by densification under a pressure of 5 tons.cm^{-2}. Each pellet was first heated at 623 K for 4 hours. Conductivity measurements were carried out in the temperature range 473-773 K and frequency range 5-13 MHz using the complex impedance spectroscopy. The obtained results show that:

1- The equivalent analog electrical circuit, for the three sulfates, is an association of a capacitance C and a resistance R in parallel.
2- Conductivity increases with temperature and follow the Arrhenius law indicating a semiconductor behavior (Figure 1).
3- For a given temperature, the conductivity depends on the nature of the divalent metal (Mg, Ni and Co). At 648 K the conductivity of the three salts varies as follows: $\sigma(Mg) = 14.10^{-6} < \sigma(Co) = 47.10^{-6} < \sigma(Ni) = 58.10^{-6}$ S cm^{-1}.
4- The anhydrous salts with Ni and Co show the lowest activation energy of the ionic conduction process Ea = 0.68 eV, while the one with Mg shows the highest value Ea = 0.97 eV.

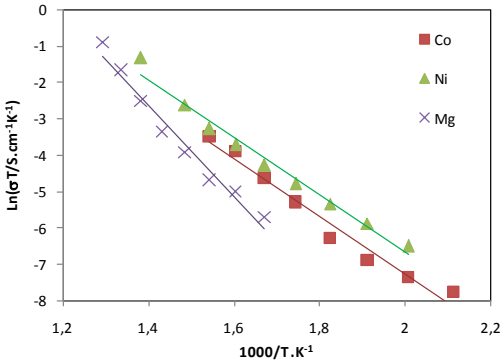

Figure 1: Arrhenius plots of the three anhydrous salts

Keywords: Sulfates ionic conductors, Complex Impedance Spectroscopy, Activation Energy

Effect of working pressure on the properties of NbN films grown on Si substrate

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Niobium nitride (NbN) thin films early got noticed because of their transition temperature, one of superconducting properties, as low as 16-17 K and thereby could find wide applications in superconducting microelectronics [1]. NbN, as a transition metal nitride, has become a very popular material due to its high hardness, melting point, wear resistance [2], chemical inertness [3] and temperature stability [4], which makes it suitable for use as emission cathodes [5] in the solar sensors at high performance [6, 7].
In the present work, we examine the effect of working pressure on the structural and optical properties of, DC reactive magnetron sputtering, NbN thin films. The studied films were grown on glass and Si (100) substrate.
The XRD patterns, of the films elaborated at 10^{-2} mbar, showed the formation of the polycrystalline phase of NbN with cubic structure and (111) preferential orientation. Microscopy analysis showed that the films displayed a uniform surface without any micro-cracks. The optical characterization by the Spectroscopy UV- visible in the spectral range from 300 to 2500 nm showed that these films are transparent in the VIS-IR.

Keywords: Reactive magnetron sputtering, NbN thin films, Optical properties.

References

[1] Jouve G, Severac C, Cantacuzene S. XPS study of NbN and (NbTi)N superconducting coatings. Thin Solid Films 1996; 287: 146-153.
[2] Singer I L, Bolster R N, Wolf S A. Abrasion resistance, microhardness and microstructures of single-phase niobium nitride films. Thin Solid Films, 1983; 107: 207-215.
[3] Baba K, Hatada R, Udoh K. Structure and properties of NbN and TaN films prepared by ion beam assisted deposition. Nuclear Instrument and Methods in Physics Research B 1997; 127-128: 841-845.
[4] Hotovy I, Huran J, Búc D. Thermal stablity of NbN films deposited on GaAs substrates. Vacuum 1998; 50(1-2): 45-48.
[5] Gotoh Y, Nagao M, Ura T. Ion beam assisted deposition of niobium nitride thin films for vacuum microelectronics devices. Nuclear Instruments and Methods in Physics Research B 1999; 148: 925-929.
[6] C. Troadec, R. Fillit, P. Goeuriot, P. Verdier, Y. Laurent, J. Vicens, G. Boitier, J. L. Chermant and B. L. Mordike, Materials Science Forum, 217-222, 1877 (1996).
[7] Fitzmaurice J.C., A.L. Hector, I.P. Parkin, J. Chem. Society Dalton Trans. 2435 (1993).

The effects of organoclay on the mechanical, thermal and rheological properties of Polychloride Vinyl polymer

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The aim of this work was to study the effects of an organomontmorillonite or organoclay (OMMT) on the properties of a polychloride vinyl (PVC) polymer. The resulted nanocomposite blend, based on organoclay and PVC polymer, was prepared by melt blending. The results obtained showed a slight improvement of the blend mechanical properties (tensile strength, and elongation at break) when the amount of the organoclay was 3 wt %. The thermal stability (deshydrochloration test) is maximal when the concentration of the organoclay was equal to 3 wt %. The water uptake study reveals that the amount of the absorbed water does not exceed 0.1 wt % when the concentration of the organoclay is 1.8 wt %. A rheological test revealed that the addition of organoclay had not increased the melt viscosity of the PP/OMMT nanocomposite blend.

Keywords: Organoclay; PVC, Mechanical properties, Thermal stability, Rheological test.

Experimental investigation on the corrosion inhibition characteristics of mild steel XC52 by a novel Schiff base in hydrochloric acid solutions

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Mild steel is used in mass amounts in marine applications, chemical processing, petroleum production and refin, construction and metal processing equipment, despite its relatively high cost. These applications usually induce serious corrosive effects on equipment, tubes and pipelines made of iron and its alloys. Hydrochloric acid is the most difficult of the common acids to handle from the standpoints of corrosion and materials of constructions. Extreme care is required in the selection of materials to handle the acid by itself, even in relatively dilute solutions or in process solutions containing appreciable amount of hydrochloric acid. This acid is very corrosive to the most of metals and alloys. Among corrosion prevention and control methods, the use of organic inhibitors is the most practical and frequently used. Generally, organic inhibitors inhibit metallic corrosion by adsorbing on the surface and thereby forming a protective barrier between the metal and the electrolyte (1MHCl). The adsorption of this inhibitor on metallic surface depends on several factors such as molecular size of inhibitor, nature of substituents, nature of metal and electrolyte. Organic compounds containing heteroatoms including nitrogen, sulfur and/or oxygen with polar functional groups and conjugated double bonds have been reported as effective corrosion inhibitor. The Schiff's bases are an important class of compounds characterized by the presence of –CH=N– group. Schiff's bases constitute a potential class of corrosion inhibitors and in addition, they have many interesting properties and extensive applications in medical, agricultural, pharmaceutical field and materials science. Due to the great degree of flexibility and diverse structural aspects, a wide range of Schiff bases have been synthesized and utilized as corrosion inhibitors for metal in aggressive media. A novel Schiff was synthesized and its inhibitive properties on mild steel XC52 corrosion in HCl was investigated using potentiodynamic polarization and electrochemical impedance spectroscopy. Polarization curves indicate that the studied compound acted as mixed type inhibitor. All measurements showed that, inhibition efficiency increase with the increasing of the inhibitor concentration. Adsorption of this inhibitor follows Langmuir adsorption isotherm. The degree of surface coverage values obtained from polarization and impedance techniques are in good agreement. The thermodynamic parameters such as $\Delta G°$, $\Delta H°$ and $\Delta S°$ were determined.

Keywords: Mild steel XC52, –CH=N– group, Schiff base, Inhibitor of corrosion.

Electrochemical and structural study of new cathode materials for SOFC

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La_2NiO_4 doped Eu powders denoted as $LNEO_x$ (for x=0, 0.02, 0.04, 0.06, 0.08 and 0.1), were synthesized via the mechanical milling reaction method. The Eu^{3+} doping content has a remarkable influence on structural and electrical properties. The phase identification and morphology were studied by X-ray diffraction (XRD), Raman spectroscopy, Infrared spectroscopy(IR) and scanning electron microscopy (SEM). Lattice parameters were calculated by the Rietveld method. It was observed that the lattice parameter values in $LNEO_x$ systems varied with the amount of Eu^{3+}. The later was symmetrically deposited by spin coating on both surfaces of $Ce_{0.8}La_{0.2}O_{1.9}$ (SDL)electrolyte and were studiedusing AC impedance spectroscopy. The electrical properties was studied using two-probe impedance spectroscopy and results showed that the ASR of $LNEO_x$ enhanced by Eu^{3+} dopant content x. Results also showed that $LNEO_{0.04}$ had the lowestt ASR at 700°C. It was therefore concluded that co-doping with the appropriate amount of Eu^{3+} can further improve the properties ofnickelate cathode.

Keywords: Cathode, Nickelate, Solid oxide fuel cell, ASR,

Corrosion behavior of reinforcing steel in concrete elements in alkaline medium

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Corrosion of steel in reinforced concrete is complex. When chloride ions and oxygen reach reinforcing steel, corrosion is initiated. The deterioration process starts with expansions of bare steel substrate, cracks in the concrete are then developed. The aim of this work is to determine firstly, through the electrochemical technique, the critical concentration of chloride ions which are responsible for the initiation of the dissolution step. Then, the effect of the external parameters on the rate of chloride ion penetration into the concrete are also evaluated. For this propose, the electrochemical bahavior of structural steel "E24" is studied in carbonate medium without and with different concentrations of chloride ions. The effetct of various parameters such as temperature, ions concentration and solution pH was also evaluated through the evolution of open circuit potential, d.c polarization measurment and electrochemical impedance spectroscopy. The d.c polarization and EIS results shows that the addition of 0.5 M $CaCl_2$, as the critical concentration, to the saturated $Ca(OH)_2$ solution, brings a rapid and continuoes dissolution of the substrate where after 3 hours of immersion time, the whole of the surface substrate was covered by corrosion products. This is may be due to specific adsorption of Cl^- ions. According to Raman, SEM and EDS analysis of the surface after immersion in corrosive media, the composition of rust layer is mainly composed of γ-FeOOH, β-FeOOH and α-Fe_2O_3.

Keywords: Reinforcing Steel, d.c polarization, EIS, Alkaline medium, Chloride ions

Synthesis, spectroscopic characterization, electrochemical properties and biological activity of (Z)-4-(2-hydroxyanilino) pent-3-en-2-one and its Mn (III) complex

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The non-symmetrical bidentate Schiff base derived from aromatic amines and 2,4-pentanedione and their metal complexes have a wide variety of applications in many fields, biological, inorganic and analytical chemistry.In azomethine products, the bond C=N is essential for antibacterial, antifungal, anticancer and diuretic activities. The nature of the metal ion in Schiff bases complexes and the sequence of donor sites of the corresponding ligands affect highly the pharmacological activity of these species. Here, we report the synthesis, structural and spectral characteristics of Mn(III) complex $Mn_2(L)Py_4Cl_4(H_2O)_6$ obtained by a condensation of 2,4-pentanedioneand 2-aminophenol. This Schiff base and its Mn(III) complex were characterized by ^{1}HNMR, ^{13}CNMR, EA, IR, UV-Vis, XRD, and Cyclic Voltammetry. Conductance values indicate that these compounds have not electrolytic character. The electrochemical behaviors of the ligand (HL) and its manganese (III) complex have been investigated using glassy carbon electrode in the presence of 0.1 M Bu_4NClO_4 in dimethylformamide. The redox system of manganese (III) complex seems to be consistent with a quasi-reversibleone.

Keyword: Bidentate Schiff base, C=N, $Mn_2(L)Py_4Cl_4(H_2O)_6$, Cyclic Voltammetry.

Electropolymerisation of Polyaniline Thin Films on Indium Tin Oxide Substrate

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This study presents the electrochemical synthesis of polyaniline (Pani) films on indium tin oxide (ITO) substrate in acidic medium by potentiodynamic and potentiontatic methods. The effects of cycle number and deposition potential on the electrodeposition of the films are described. Cyclic voltammogram recorded on the ITO substrate in 0.5 M H2SO shows that the initial stages of the aniline electropolymerization were started at 0.75 V/SCE.
Applied potentials of (0.75, 0,85 and 0,95 V) were used the deposit Pani films in potentiostatic mode. Results show that by increasing the applied potential, the oxidation current density decreases and the growth of the film becomes faster. A green color polyaniline film that depends on the applied potential was deposited on the working electrode. The influence of the applied potential on the surface morphology was investigated by scanning electron microscopy (SEM) coupled with energy dispersive X-ray analysis (EDX).

Keywords: Electropolymerization, Chronoamperometry, Cyclic voltammetry, Polyaniline.

Study of the complexation of metallic ions Cu^{+2} and Zn^{+2} by electrochemical poly –dibenzo crown ether

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The present work deals with the study of Cu^{+2} and Zn^{+2} metallic ions in aqueous medium, by electrochemical poly-dibenzo crown ether, as a function of three parameters, temperature, time and concentration. The electrodeposition process and the characterisation of the material obtained were examined by cyclic voltammetry, IR, UV vis, and electrochemical impedance spectroscopy. This work showed that doped polymers may have a high electric conductivity.

Key words: Electrochemical, Polymerisation, Complexation, Metallic ions, Conductivity.

Effect of pH and NaCl concentration on biocorrosion behavior of the interface carbon steel / industrial wastewater

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During the past five decades biocorrosion or Microbiologically Influenced Corrosion (MIC) has been recognized as an important category of corrosion. Owing to its environmental and economic impact, MIC has been the subject of extensive research. In this study, we reported the effect of pH variation and NaCl concentration on biocorrosion behaviour of the interface carbon steel submerged on acclimated microflore of industrial wastewater. The biocorosion process was evaluated using electrochemical measurements and microbiological analyses.
At pH 3, the bacterial biofilm constituted on the surface was characterized by its reversible adhesion due to the presence of microbial microflora with hydrophilic behaviour accelerating the biocorrosion rate. At pH 9, the corresponding biofilm was characterized by its irreversible attachment parallely with an hydrophobic behaviour of bacteria demonstrated with MATS technique. In this case, the biofilm seems to increase the resistance of the interface and consequently improve the protection of the carbon steel.
In the second part of study, we focused on the effect of NaCl concentrations on biocorosion process. A concentration of 0.5g/L de NaCl was suitable for constitution of an adherent biofilm on the surface of carbon steel providing a protector effect to the metal. However, 1g/L of NaCl emphasized the aggressive effect of chlorides ions accelerating the biocorsion progress.This is in accordance of the non adherent bihaviour of the biofilm on the surface of the metal.

Keywords: Biocorrosion, Microflore, Bacterial biofilm, Carbon Steel,

Lycium ferocissimum extracts as green corrosion inhibitors Study of the effect of phenolic compounds on the corrosion of carbon steel in 3M NaCl solution

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Plants have always provided food, fuel, food additives, drugs, pesticides, pigments, resins, perfumes and other important industrial, medicinal and agricultural raw materials. In recent years, plant extracts have become the focus of corrosion inhibitor research due to their low toxicity and easy availability [1,2].
This work is devoted to the corrosion inhibition of Carbon steel in 3M NaCl medium solution by phenolic extracts from wild edible fruits: *Lyciumferocissimum*. In the literature, phenolic subclasses could be used temporarily to prevent the corrosion of steel with inhibition rates higher than others compounds such as terpenoids, alkaloids, fatty acids [3]. The first part of this work studies the influence of concentration, immersion time and temperature on the corrosion process of carbon steel in 3M NaCl medium solution in the absence and/or presence of inhibitor by electrochemical measurements: polarization curves and electrochemical impedance spectroscopy. The second part was devoted to the identification attempt of fruits extract's phenolic compounds that are responsible of the inhibitory activity and thus to determine the adsorption mechanisms.
The results revealed that the richest extracts in phenolic compounds have the most important inhibitory effect. The corrosion rates were observed to decrease with the increase of phenolic content extract, which confirms that the inhibitory power is due in part to the antioxidant activity of the flavonoids and that the antioxidant activity varies according to the type of the groupment positioned on the aromatic ring of the phenolic molecule.

Keywords: *Lyciumferocissimum*, Phenolic compounds, Corrosion Inhibitor, Carbon steel, Electrochemical measurements.

References

[1] Abdel-Gaber, A.M., Abd-El-Nabey, B.A., Sidahmed, I.M., El-Zayady, A.M., Saadawy, M., 2006. Inhibitive action of some plant extracts on the corrosion of steel in acidic media. Corrosion Science. 48, 2765-2779.
[2] Abdallah, M., Basim H.A., I., Zaafarany, I., Fouda, A.S., 2012. The Inhibition of Carbon Steel Corrosion in Hydrochloric Acid Solution using Some Phenolic Compounds. International Journal of Electrochemical Science. 7, 282-304.
[3]Abiola, O.K., James, A.O., 2010. Gossipiumhirsutum L. extracts as green corrosion inhibitor for aluminum in NaOH solution. Corrosion Science. 52, 661-664.

Effect of additives on the performance of positive lead-acid battery plate

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The present work aims to study the effect of the addition of a surfactant (SDS) in the electrolyte on the composition of PbO_2, its electric performances as a positive active mass and on the cycle life of lead-acid battery. The results show that the addition of surfactant in sulfuric acid before oxidation influences the composition and the crystal size of the PAM after oxidation. We observe a remarkable improvement of the discharge capacity of the PAM containing SDS. Nano-sized particles of PbO_2 with amorphous character are obtained. This shows that the addition of the surfactant to the PAM, the electrical performance and the cycle life of lead- acid battery are significantly increases. XRD, galvanostatic discharge and *electrochemical impedance*spectroscopy (EIS) were used as techniques of investigation.

Keywords: Positive Plate, Additives, Discharges capacity, Lead-acid Battery, Cycle life.

Analysis of internal corrosion in crude oil transportation pipeline

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Pipeline plays an important role in oil and gas in oil and gas transportation. Up to now, pipeline is the most economical and efficient means of fluid transportation (crude oil and natural gas) compared to rail, truck and tanker transportation in term of route flexibility and high capacity transport system. Pipeline is commonly made from carbon steeldue to its good mechanical proprieties, low cost andwide availability despite of its relatively low corrosion resistance [1]. Normally, as an oil well ages, the production of oil starts to decline whereas water and gas flow rates tend to increase. The presence of highly corrosive agents such as CO_2, H_2S and chlorine compounds, which are dissolved in fluids can accelerate corrosion process inside the pipeline [2,3]. Therefore, the impact of changes in fluid composition on corrosion resistance of a pipeline should be anticipated during maintenance program.

The defect of a crude oil API 5L X52 steel pipeline which led to oil leakage has been reported to occur after several years. Some leaks were found to form at the bottom of the API 5L X52 steel pipeline near an elbow section, which connected the pipeline to a riser. The present investigation aims to analyze the main cause of defect by conducting standard defect analysis methods including visual examination, chemical and mechanical characterizations, metallurgical examinations using optical microscopy coupled with morphological characterization performed by AFM atomic force microscopy and electrochemical corrosion testing using a three electrodes cell. Results of this investigation suggests that the cause of defect is an electrochemical corrosion combined with mechanical process known as flow-induced corrosion. The defect mechanism is related to fluid flow rate and chloride containing water phase. Defect mechanism of pipeline due to flow-induced corrosion is described in **Fig. 1**.

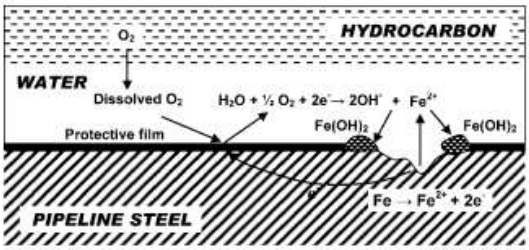

Fig.1: Proposed mechanism of flow induced corrosion in oil pipelines

Keywords : Pipeline, Acier au carbone, Huile brute, Corrosion induite par le flux, AFM.

References

[1] Tawancy HM, Al-Hadhrami LM, Al-Yousef FK. Analysis of corroded elbow section of carbon steel piping system of oil-gas separator vessel. Case Studies in Engineering Failure Analysis, **1**, 6–14 (2013).
[2] Rodriguez MALH, Delgado DM, Gonzalez R, Unzueta AP, Solis RDM, Rodriguez J. Corrosive wear failure analysis in a natural gas pipeline. Wear, **263**, 567–71 (2007).
[3] Palmer AC, King RA. Subsea pipeline engineering. Oklahoma: PennWell, (2004

Effect of a surfactant additive on the electrochemical on Behaviors of Nanostructured Lead Dioxide Lead-Acid Battery: application to the degradation of RS azo dyes

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The aim of this study is to improve the performance of the positive electrode of lead-acid battery, which suffers from low efficiency of about 50%, low energy density and short cycle life. The use of the surfactant in the PAM increase the capacity and cycle life of the positive electrode (PbO_2).The results showed that the addition of surfactant (STTP) in the paste before oxidation improvesremarkably the discharge capacity of the PAM for a ratio of surfactant ranging between 0.2and 1.2%. This capacity depends on the total water content present in the gel part of PbO_2.This shows that the addition of surfactant to the active material is essential for improving theelectrochemical reactivity of PAM. The direct electrochemical oxidation of the dye RS showthat PAM contains the surfactant has an important effect on the rapid and total conversion ofthe azo dyes RS, compared to the PAM without surfactant.

Keywords: Additive, Discharge capacity, Lead-acid Battery, PAM, Azo dyes RS

Effect of the synthesis method and the substrate on the structural and optical properties of the ZnO thin films elaborated electrochemically

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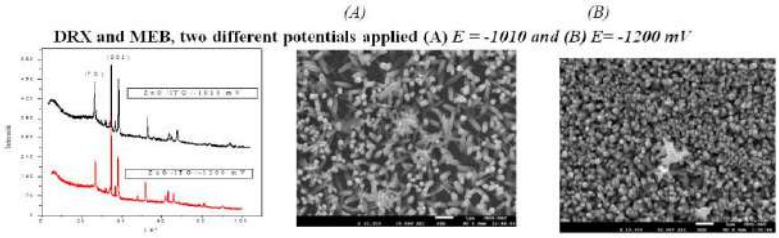
Cyclic voltamperometry and chronoamperometry methods were used to prepare ZnO thin films. XRD study shows that ZnO thin films crystallizes according to the compact hexagonal phase (Würtzite type) and has a preferential direction of growth: the c axis of the crystalline structure. Morphological characterization was done by scanning electron microscopy (SEM) showed nanowires.
ZnO nanowires deposited by means of cyclic voltammetry and chroamperometry are comparable, the only difference lies in the density and size of nanowires obtained.
However, nanowires deposited on silicon substrate are quite different from those obtained with the two methods. The study of optical properties showed that absorptions and transmissions are a function of potentials and methods applied.



Keywords: DRX, Potential, Electrodeposition, Transmission, MEB.

References

[1] F. Oliveira, M.P. Proenca, J.P. Araújo and J. Ventura 'Electrodeposition of ZnO thin films on conducting flexible substrates' Journal of Materials Science, ,Vol 51, pp 5589–5597,2016
[2]G.Nagaraju, K. YH and Y. JS, Mater Chem Phys vol 149, pp 393–399, (2015).
[3] Xu S, Qin Y, Xu C, Wei Y, Yang R and Wang ZL, Nat Nanotechnol vol 5, pp366–373, (2010).
[4]: FA. Cataño, H. Gomez, EA.Dalchiele, RE. Marotti, Int J ElectrochemSci vol 9, pp 534–548, (2014).

Study of electrochemical behavior of pur magnesium in a physiological medium

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Magnesium and its alloys have been often used as material for biomedical applications, such as in orthopedics [1] and in cardiovascular stents [2].Thanks to its unique mechanical properties, reasonable strength, biodegradability and biocompatibility, Magnesium is considered as the future of biodegradable implants and becoming the most promising substitutes for tissue regeneration for impaired bone, vascular and other tissues.

In this work, the electrochemical behavior of pure magnesium was investigated in a physiological medium to evaluate its corrosion resistance in vivo [3]. The mechanisms governing magnesium corrosion, in particular the hydrogen reduction reaction was discussed [4]. The study was carried out using various electrochemical techniques such as the open-circuit potentiometry (OCP), linear voltammetry (LV) and electrochemical impedance spectroscopy (EIS), in a simulated physiological solution. The use of the rotating electrode allowed better control of the hydrodynamic conditions.

Keywords: Magnesium, Physiological solution, Linear Voltammetry, Electrochemical Impedance Spectroscopy.

References:

[1] Sankalp Agarwal, James Curtin, Brendan Duffy, Swarna Jaiswal, Biodegradable Magnesium Alloys for Orthopaedic Applications: A Review on Corrosion, Biocompatibility and Surface Modifications, J. Materials Science & Engineering, (2016).

[2] PlamenBokov, Patrice Flaud, Du stent coronaire en métal au stent biodégradable, J. Sang Thrombose Vaisseaux, vol. 9, pp. 465-476 (2011).

[3] A. Zakiyuddin, K. Yun, K. Lee, Corrosion behavior of as-cast and hot rolledpure magnesium in simulated physiological media, J. Met. Mater. Int. 20 pp.1163–1168 (2014)..

[4] N.I.Z. Abidin, D. Martin, A. Atrens, Corrosion of high purity Mg, AZ91, ZE41 and Mg2Zn0.2Mn in Hank's solution at room temperature, J. Corros. Sci. 53 pp. 862–872 (2011).

Extraction and characterization of Artemisia herba alba oil and its application as green inhibitor of pure aluminum corrosion in HCl medium

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Acid plays a very important role in the industry especially in scrubbing, industrial cleaning, acid pickling, etc…. However, the action of these agents alters metals and can sometimes, in addition to the cost, lead to serious accidents. The use of corrosion inhibitors to combat this phenomenon is effective, but the synthetic compounds are nevertheless highly toxic and most of them are banned. As a result, the use of oils and plant extracts has attracted the interest of the scientific community as a good source of ‘‘green’’ inhibitors. It is in this context that our present study took place. Indeed, starting from a green plant in this case the Artemisia, picked in the east of Algeria, the essential oil is extracted to study its effectiveness in protecting pure aluminum against corrosion in hydrochloric acid medium (1 mol.L^{-1}). The extraction of the oil was carried out by hydrodistillation with a yield that varied between (0.9 - 1.1%). The obtained extract was then characterized by gas chromatography coupled with mass spectroscopy. The inhibition efficiency was evaluated by electrochemical measurements (temporal variation of abandonment potential, potentiodynamic polarization, electrochemical impedance spectroscopy) and gravimetric measurements. The results indicate an increase of the protection efficiency with the inhibitor concentration to reach 95% for an optimum concentration of 0,8g/L of inhibitor and that the Artemisia oil acts as cathodic-type inhibitor.

Keywords: Green inhibitor, Artemisia oil, Pure Aluminum, HCl medium, Corrosion

References

[1] Khadraoui, A., Khelifa, A., Hachama, K., *et al. Journal of Molecular Liquids*, 2016, 214, 293-297.

[2] J.Halambek, A.ŽutinićandK.Berković. *Int. J. Electrochem. Sci*, 2013, 8, 11201-11214.

Correlation of antioxidant activity and electrochemical behavior of a novel copper(II)-complex, $\{(H_3O^+)_2[Cu(II)(\mu\text{-}P_4O_{12})(cyclam)]\}_n$

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Electrochemical methods provide high potential for antioxidant compounds investigation and assessment of their antioxidant capacity, which is defined as the ability to inhibit the oxidative degradation. Oxidative damage to all cell types results primarily from chemical insult via a surplus of short-lived, highly reactive metabolites designated by their chemically reactive heteroatom, such as reactive oxygen species (ROS). These metabolites consist of free radicals, such as the hydroxyl radical ($OH^{\bullet}$) and superoxide anion ($O_2^{\bullet}$) [1]. Currently, several pathophysiological events such as cancer have been associated with an increase in ROS generation and concomitant oxidative stress [2]. Therefore, there is a growing interest in the synthesis of new metal complexes with antitumor activity. It has been reported that transition-metal complexes incorporating tetraazamacrocyclic ligands, such as cyclam or cyclam derivatives exhibit antitumor activity [3]. On the basis of the above-mentioned points, we attempted to evaluate the antioxidant capacity of the new elaborated complex, $\{(H_3O^+)_2[Cu(II)(\mu\text{-}P_4O_{12})(cyclam)]\}_n$.The biochemical properties of this complex were evaluated via DDPH, ABTS, hydroxyl radical scavengers and ferric reducing power (FRP) showing promising antioxidant activities which has been clarified by means of the cyclic voltammetry study. According to this investigation, the title complex exhibits an easier ejection of electron and consecutive proton transfer, thus its good antioxidant activity might be attributed to an electronic transfer coupled to this of protons.

Keywords: $\{(H_3O^+)_2[Cu(II)(\mu\text{-}P_4O_{12})(cyclam)]\}_n$, Antioxidant, Cyclic voltammetry, Electron transfer, Proton transfer.

References

[1] B. Halliwell, M. Whiteman, .231 (2004) (2)142 .locamrahP .J .rB
[2] T. P. Ribeiro, C. Fernandes, K. V. Melo, S. S. Ferreira, J. A. Lessa, R. W. Franco, A. Horn, Free Radic. Biol. Med. 80 (2015) 67.
[3] J. W. Sibert, A. H. Cory, J. G. Cory, Chem. Commun. 2 (2002) 154.

Removal of copper from aqueous solution by adsorption onto activated sawdust

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Sawdust is known as an abundantly available from the timber and forest industry and has been studied in recent past as an adsorbent. Indeed, considerable attention has been devoted to the study of removal of heavy metals from wastewater by adsorption using agricultural products and by-product. In this work sawdust, an available and renewable biomass, was investigated as a novel adsorbent.Activated sawdust by phosphoric acid was used to remove copper from aqueous solution

The effect of contact time and initial metal ion concentration on metal ion removal has been studied. The adsorption data of metal ions at temperatures of 25 degrees C have been described by the Freundlich and Langmuir isotherm models.

Keywords: Sawdust,Adsorption, Copper, Isotherm.

Application of functionalized nanoparticles in the field of biosensors

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Nowadays nanotechnology is creating a wealth of new materials and manufacturing possibilities, which in turn will profoundly impact our economy, our environment, and our society. The use of nanotechnology, more specifically, nanoparticles, in the field of medicine offers some exciting possibilities such us diagnosing and treating some pathologies (cancers, Alzheimer, infections…)[1,2]. In this work we report a protocol for the synthesis and the functionalization of ZnO and ZnS-AgInS_2 (ZAIS) nanoparticles with single stranded oligonucleotide. The binding of DNA to these particles was achieved through a covalent binding via a carbodiimide activation. The combination of the optical proprieties of those quantum dots (QDs) and DNA melting characteristics contributes to the development of new DNA detection technologies with remarkably high selectivity and efficiency.

Keywords: Nanoparticles, ZnO, ZAIS, Oligonucleotide.

References:

[1] G. K. Kouassi and J. Irudayaraj, "Magnetic and Gold-Coated Magnetic Nanoparticles as a DNA Sensor," vol. 78, no. 10, pp. 3234–3241, 2006.
[2] P. Bakthavathsalam, V. K. Rajendran, J. Ali, and B. Mohammed, "A direct detection of Escherichia coli genomic DNA using gold nanoprobes," pp. 1–10, 2012.

Evaluation of the inhibitive effect of *Cynara Cardunculus* leaves extract on st37 steel corrosion in Tunisian seawater contained in a hypochlorite solution

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The presence of chloride ions (Cl^-) in bleach solutions (sodium hypochlorite solutions) is responsible for both crevice and pitting corrosion on stainless steels [1,2].
Bleach is widely used for food disinfection and cooling water treatment, due to its excellent bactericidal efficacy and modest cost [3]. In this context, the power plant, STEG, is considered as a real applicable case. In this company, seawater is used as a cooling fluid which circulates in the condenser. Sodium hypochlorite solution, which is used as a bleaching agent and disinfectant, is added to the system. Sea water containing bleach is a very aggressive solution which promotes corrosion.
During the last two decades, a lot of attention has been paid to the area of ‘‘green inhibitors’’. These are the most efficient molecules that have a low or ‘‘zero’’ effect on the environment and on human health [4]. This project focused on the effect of *Cynara Cardunculus* leaves extract against corrosion of Low Carbon Steel in a seawater medium containing a bleach solution.
The corrosion inhibition was investigated by means of potentiodynamic polarization and electrochemical impedance spectroscopy (EIS) measurements. The results showed that *Cynara Cardunculus* extract could play a significant role as a corrosion inhibitor for low carbon steel St37 in seawater with a hypochlorite environment. The Potentiodynamic polarization (PDP) results, reveal that the extract components act principally as mixed type inhibitor. The dissolution rate decreased with the increase of the *Cynara Cardunculus*extract concentration. Surface analysis of the samples was performed by Scanning Electron Microscopy coupled with chemical analysis (SEM-EDS).

Keywords: Low Carbon Steel, Seawater, *Cynara Cardunculus*, Electrochemical Impedance Spectroscopy.

References:

[1] L. Kerherve, G. Daufin, F. Michel. Corrosion of stainless steels by bleach solutions. Milk, INRA Editions, 1983, 63, 625-626.
[2] GAUR et al, “Corrosion of mild steel in hypochlorite solution- An electrochemical and weight-loss study”; Indian Journal of Chemical Technology, 1994, Vol.1, 225-229.
[3] H. Tuthill, E. Avery, S. Lamb, G. Kobrin. Effect of Chlorine on Common Materials in Fresh Water, Materials Performance, 1998, Vol. 37, 52-56.
[4] N. Patni, S. Agarwal, P. Shah, Greener Approach towards Corrosion Inhibition, Chinese Journal of Engineering, 2013, Vol.2013, 10.

The inhibition Activity of 1,10-bis(2-formylphenyl)-1,4,7,10-tetraoxadecane (Ald)

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The use of corrosion inhibitor is one of the most effective measures of protecting metal surfaces against corrosion in acidic environments. Some organic compounds are found to be effective corrosion inhibitors for many metals and alloys. Generally, inhibitor molecules may physically or chemically adsorb on the metal surface forming an adsorption layer that functions as a barrier protecting the metal from corrosion.
Acid solutions are widely used to remove unwanted sediments and rust in many industrial processes. Adsorption depends on the charge on a metal but on the chemical structure of the inhibitor.
Organic compounds containing heteroatoms such as N, O and S have been reported as being efficient corrosion inhibitors for metals.
The aim of the present work is to investigate the inhibitory action of aldehyde, named 1,10-bis(2-formylphenyl)-1,4,7,10- tetraoxadecane(**Ald**).
The research was done on carbon steel XC48 in HCl 1M aggressive medium by electrochemical methods and weight loss. The compound is an efficient corrosion inhibitor and its inhibition efficiency is increased with increasing inhibitor concentration.

Keywords: 1,10-bis(2-formylphenyl)-1,4,7,10-tetraoxadecane, Inhibition Activity, Carbon steel XC48, Electrochemical methods.

Electrochemical obtaining of polypyrrole multiwalled carbon nanotube composite films

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The growing interest in application of polypyrrole is attributed to high specific properties such as capacitance, high electrical conductivity, low cost, advanced chemical and mechanical properties of this material [1]. Another strategy is based on the fabrication of PPY-Carbone nanotube (CNT) composites [2]. CNT are usually added to active materials in order to increase the electronic conductivity of the composite electrodes and improve the power density. The use of CNT as conductive additives offers benefits of their high surface area and low percolation threshold. Therefore, the fabrication of PPY/CNT electrodes requires efficient dispersion of CNT in the PPY matrix and optimization of the CNT content in the composites. In order to achieve this goal, this study was investigated; the nanocomposite films of polypyrrole and multiwalled carbon nanotubes (MWCNT) were electrochemically synthesized by direct oxidation of pyrrole (10^{-2} M) in 0.1 M aqueous solution of lithium perchlorate containing a certain amount of MWCNT. The key parameter of this study was the amount of MWCNT in the solution and the film thickness. The electrochemical properties of the obtained composite films such as, electronic conductivity, capacitance, and the electrochemical stability have been studied by cyclic voltammetry and electrochemical impedance spectroscopy. It was found that the mixing sequence of the monomer and the MWCNT ratio strongly influenced the compositions of the composite films and consequently the increase of the composite's capacity. This study indicated that the contents of the MWCNT incorporated in the composite films increased with the increase of amount of MWCNT in the solution during the electropolymerization of pyrrole process. This new nanocomposite electrode material could be used as electrochemical supercapacitor.

Keywords: Polypyrrole, Composite material, MWCNT, Cyclic Voltammetry, Impedance Spectroscopy, Supercapacitor.

References

[1] G.A. Snook, P. Kao, A.S. Best, Journal of Power Sources 196 (2011) 1-12.
[2] J. Wang, Y. Xu, F. Yan, J. Zhu, J. Wang, F. Xiao, Journal of Solid State Electrochemistry 14 (2010) 1565-1575.

Application of poly-oligothiophene /Ag for the detection of cadmium in water

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The high application potential of conducting polymers (CP) in chemical and electrochemical sensors is one of the main reasons for the intensive investigation and development of these materials [1, 3].The combination of noble and transition metals with conducting polymers films have been extensively studied because of their interested electrochemical and electronic properties of the metals as well as the high conductivity and stability of the polymer [4].
In the present work, a composite material of one of the most important polyoligothiophene (polyterthiophene) Poly(3T) and silver nanoparticles was electrochemically synthesized. This new material was obtained from a solution of (CH_3CN/LiClO4 0.1M) containing the monomer (terthiophene) with cyclic voltammetry then, the resulted polymer film was conditioned in silver nitrate solution for the optimized time. The obtained material was characterized using Cyclic Voltammetry, Electrochemical Impedance Spectroscopy and Square Wave Voltammetry. The results show that the addition of silver particles in polyterthiophene films matrix increased the film conductivity and its electroactivity. For this reason, they have been envisaged for the detection of one of heavy metals which was the cadmium in water for environment interest.The study was carried out by studying some parameters that can influence the sensibility of the sensor for traces detection.The results show that the composite material polyterthiophene/Ag can detect the cadmium and the effect of Ag particles improves the limit of detection lower than 10^{-9} M determined by square wave voltammetry.

Keywords: Polyterthiophene, Composite material, Cadmium, Cyclic Voltammetry, Square wave voltammetry.

References

[1] U. Lange, N.V. Roznyatovskaya and V. M. Mirsky, Anal. Chim. Acta, 614 (2008) 1.
[2] M.D. Shirsat, C.O. Too and G.G. Wallace, Electroanalysis. 20 (2008) 150
[3]N.Maouche, B. Nessark, I. Bakas, Arab. J. Chem (2015), http://dx.doi.org/10.1016/j.arabjc.2015.04.029.
[4] F.Terzi, C.Zanardi, V.Martina, L. Pigani, R.Seeber, J.Electroanal.chem. 619-620 (2008) 75-82.

Evaluation of corrosion protection of nanostructured carbon black filled polystyrene-block-poly(ethylene-ran-butylene)-block-polystyrene triblock copolymer coatings on copper during exposure to a quiescent 3% NaCl solution

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Organic coatings are considered among the most widely applied methods for corrosion protection of metallic materials. As a matter of fact, they exhibit a particular importance in transport and infrastructure. In this work, we have studied the effect of the immersion protocol as well as the addition of low contents of Carbon Black (CB) nanoparticles and copolymer polystyrene-block-poly (ethylene-ran-butylene)-block-polystyrene (SEBS) on the electrochemical behavior of SEBS films in order to evaluate the performance of the proposed coatings for copper corrosion prevention. The protective behavior of these latter in corrosion media (3% NaCl) was investigated using Tafel polarization curves all along with open circuit potential measurements.
The obtained results confirmed the proficient use of CB as doping agent. The anticorrosive behavior of SEBS/CB composites was found to be enhanced along with the increasing content of SEBS within the composite and that is by inducing copper passivation process.We also noted that the use of both immersions separated one of another by a drying time boosted the already obtained results.

Keywords: Copper corrosion, Triblock copolymer,Polystyrene,Corrosion prevention,

Electrochemical imprinted nano-platform for highly sensitive detection of a Chem-biomarker in biological fluids

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The research in the field of molecular recognition has attracted great concern involving several research teams. Most of the research areas are devoted to the development of new polymeric materials modified by molecular imprinting technique and has a specific affinity for certain compounds of interest [1]. These polymers (MIPs) have already shown all their potential in biosensing and have been successfully applied in ultra-sensitive diagnostics and analysis in an often-complex matrix. In this context, combining the sensitivity of electrochemical methods and the high selectivity of molecular imprinting technique has been proved to be a rapid, fast and powerful analytical tool in biosensing [2]. Here an electrochemical sensor based on nano-structured conductive polymer was investigated for in-vitro detection of a biomarker in biological fluids. The synthetized sensor was characterized by several analytical techniques, such as SEM, AFM, FTIR, etc. The MIP sensor, under optimized conditions, has shown a very good stability and high sensitivity and selectivity toward the target molecule. The obtained results have presented an excellent recovery rate (<3%) proving the promising applicability of the sensor in real matrix without any interference recorded.

Keywords: Nano-platform,Polymeric materials, Molecular imprinting technique, Sensor.

References:

1. T. Alizadeh, A. Akbari, Biosens. Bioelectron., 2013, Vol.43, 321-327.
2. Z. Fu, G. Li, Anal. Methods, 2015, Vol.7, 4590-4595.

Valorization of olive mill solid waste: removal of copper from waste water

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Olive oil is produced mainly in the Mediterranean region. In Tunisia, oil extraction industry generates high amount of two by-products which are Olive Mill Waste Water (aqueous effluent) and Olive Mill Solid Waste (solid residue). Two recovery pathways (thermal and physicochemical) were performed to reduce these wastes. Firstly, a combined process which includes impregnation on low-cost renewable absorbents and an energetic recovery via combustion was studied. Heavy metal pollution in industrial waste water has attracted global attention because of its adverse effects on the environment and human health. It is, therefore, crucial to remove these heavy metals from wastewaters effectively before their discharge into the environment. Among these heavy metals, copper is abundant in nature. In this work Olive mill solid waste was chosen as absorbent to remove copper from waste water.

Keywords: Adsorption, Pollution, Copper, Olive mill solid waste, Waste water.

Comparative study of Arylene-Cyanovinylene isomers electronic properties and their electrogenerated polymers

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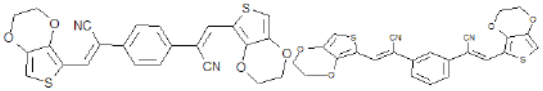
Organic π-conjugated oligomers and polymers constitute an important class of functional materials in organic electronics (OE). They are used as active layers in organic light-emitting diodes (OLEDs), organic field-effect transistors (OFETs) or in organic solar-cells (OSC). In this latter application, efficient materials usable as p-conducting layer in bulk-heterojunction (BHJ) solar cells in association with fullerene derivatives as n-conducting materials are needed.[1, 2] In fact, a material with a bandgap of 1.1 eV is able to absorb 77 % of the solar irradiation, however, semiconducting polymers or oligomers have bandgaps higher than 2 eV and can then harvest only 30 % of the solar photons. In this field, a lot of work has been done during the last forty years to synthesize conducting polymers with very low bandgap and especially those with thiophene units.[3, 4] In this area, Roncali determined the contributions that may modify the bandgap of polyaromatic linear π-conjugated systems.[4], it has been shown that polythienylenevinylene (PTV) has a lower bandgap (around 1.8 eV)[5] than polythiophene (PT) (2.2 eV).[6] The introduction in the polymer chain of the vinylic double bonds reduces the aromatic character of the -conjugated backbone and limits the rotational disorder which plays a major role in the magnitude of the bandgap in PT. Later on, it was shown that the introduction of electron withdrawing cyano groups at the ethylene linkage leads a considerable decrease of the bandgap which reaches very low values.[7].

In the present work, we studied the electrochemical behavior and the anodic electropolymerization of two arylene-cyanovinylene isomers **I** and **II** (see chart) consisting of a central phenyl unit substituted in *para* or *meta* positions by two cyanovinylene-3, 4-ethylene dioxythiophene, compound derived from thiophene which further reduces the band gap and the oxidation potential. A specific outlook is done on the influence of the phenyl substitution (*para*vs*meta*) on the electronic properties of the polymers and their precursors.



I II

Chart. Structure of the two isomers studied in this work

Keywords: Electropolymerization; Electroactive polymer; p- doping process, n-doping process; arylene-dicyanovinylene.

References:

1. T. Xu and L. Yu, *Materials Today*, 17 (2014) 11.
2. N. Kaur, M. Singh, D. Pathak, T. Wagner and J. M. Nunzi, *Synth. Met.*, 190 (2014) 20.
3. J. Roncali, *Macromol. Rapid Commun.*, 28 (2007) 1761.
4. J. Roncali, *Chem. Rev.*, 97 (1997) 173.
5. M. Catellani, S. Luzzati, A. Musco and F. Speroni, *Synth. Met.*, 62 (1994) 223.
6. T.-C. Chung, J. H. Kaufman, A. J. Heegerand W. F., *Phys. Rev. B*, 30 (1984) 702.
7. H. A. Ho, H. Brisset, P. Frère and J. Roncali, *J. Chem. Soc., Chem. Commun.*, (1995) 2309.

Synthesis of New Materials for Use As Organic Active Layers Characterization of Z (2, 3-diAryl) Acrylonitrile by Cyclic Voltammetry and Impedance Spectroscopy

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Organic π-conjugated oligomers and polymers constitute an important class of functional materials in organic electronics. They are used as active layers in organic light-emitting diodes (OLEDs), organic field-effect transistors (OFETs) or in organic solar-cells (OSC). In this latter application, efficient materials usable as p-conducting layer in bulk-heterojunction (BHJ) solar cells in association with fullerene derivatives as n-conducting materials are needed [1, 2] In fact, a material with a bandgap of 1.1 eV is able to absorb 77 % of the solar irradiation, however, semiconducting polymers or oligomers have bandgaps higher than 2 eV and can then harvest only 30 % of the solar photons.

In the last few years, the scientists seek to synthesize organic molecules having gaps similar to those of metals. Recent studies showed that the family of the poly (thienylenevinylene) (PTV) presents a gap electronic Eg lower than that of polythiophen (Pt), 1.8 and 2.1eV respectively. Other work showed that the introduction of an acceptor group into the combined chain has an advantage in the control of this forbidden band. Indeed, the substitution of the electron-withdrawing cyano group in the double connection of the poly (thienylenevinylene) leads to a polymer with a great electronic affinity.

We have synthesized monomers to study a class of soluble low band gap conjugated polymers based on heterocyclic units and cyano vinylenes. We report a sample study of one of this class of material, the poly (Z) (2-phenyl-3-furyl) acrylonitrile.Poly (Z) (2-phenyl-3-furyl) acrylonitrile film was synthesized electrochemically by anodic way in an electrolytic bath of Bu_4NPF_6 (0,2M)/CH_2Cl_2 with anhydrous conditions and under inert atmosphere. The polymer formed on Pt or ITO electrode, either by cyclic voltammetry or by potentiostatic method, was characterized by spectroscopic methods NMR, IR, UV, fluorescence and differential scanning calorimetry. Its electrochemical impedance study showed the semicircle which is a characteristic of charge-transfer resistance of the electrode/polymer interface at high frequency and at low frequency, the mass transfer process of the redox species.

Keywords: Poly Z (2-penyl-3-furyl) acrylonitrile, Cyclic Voltammetry, Impedance spectroscopy, Fluorescence.

References:

1. T. Xu and L. Yu, Materials Today, 17 (2014) 11
2. N. Kaur, M. Singh, D. Pathak, T. Wagner and J. M. Nunzi, Synth. Met., 190 (2014) 20

Evaluation of corrosion inhibition of two schiffbases on Carbon Steel in 1 M HCl

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Carbon steel are widely used in industry as the basic metal for modern materials science and engineering. Steel corrosion brings inestimable damage to the human life and production, so prevention or completely inhibiting corrosion has been an intensive filed of interest. Due to the presence of the –C=N– group in the molecule, Schiff bases exhibit effective corrosion inhibition for different metals and alloys.
The aim of this work is to study The corrosion behavior of Schiff bases on carbon steel surface in 1 M HCl measured by electrochemical impedance spectroscopy (EIS) and polarization curves. All measurements showed that, inhibition efficiency increases with increasing inhibitor concentration. Polarization curves indicate that the studied compound was acting as a mixed inhibitor.

Keywords: Carbon Steel, Corrosion Inhibition, EIS, Schiff bases, Polarization.

Modified carbon felts as efficient cathode for electro-Fenton process

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Carbon Felt (CF) is commonly used as electrode due to their good electronic conduction. It has high surface area and porosity able to provide abundant redox reaction sites, excellent electrolytic efficiency, mechanical stability, and relatively low cost [1-3].
In order to enhance electrochemical activity of CF, simple chemicals treatments are applied to pristine felts. The modification methods are described. The structure properties of modified felts are investigated.
Both pristine and modified felts are used as electrode in the wastewater treatment containing endocrine disruptor « Fluoxetine » by electro-Fenton process. The results showed that the modified samples have higher electro-catalytic activity of oxygen reduction and H_2O_2 production compared to the unmodified one. The mineralization of Fluoxetine is almost complete (96 % TOC removal) after 8 h treatment.
The modified electrodes are stable and reusable, indicating that the reported chemical modification is a promising alternative to improve the efficiency for electro-Fenton system, and thus benefits to promote its environmental applications.

Keywords: Carbon Felt, Modified electrodes, Electro-Fenton process, Electro-catalytic activity.

References:

[1] Smith, R. E. G.; Davies, T. J.; Baynes, N. de B.; Nichols, R. J.; The electrochemical characterization of graphite.
[2] Zhou, M., Oturan, M. A., Sirés, I., Electro-Fenton Process: New Trends and Scale-Up, Springer, 2017, p147.
[3]Wei, L., Lipeng X., Xin X., Qida L., Ming Z.; Shujiang D., Mingshu Z., XiaojieL.,Scientific Reports, 5 (2015) 9277.

Phenyl phosphate as Ni-Cr alloy dissolution inhibitor: Experimental investigation

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Ni-Cr alloys latter are largely used in range industrial applications and widely utilized in dentistry for dental prosthesis making [1-3]. They have shown that Ni-Cr alloys release an important quantity of metallic ions, which could pollute industrial wastewater and induces adverse toxic reactions in human body. Moreover, the corrosion causes life-threatening damage to Ni-Cr alloy structures causing financial punishment in terms of renovation or replacement. The aim of the present study is to investigate the effect of use of the phenyl phosphate (PP) on Ni-Cr alloy dissolution, and to understand at the atomic scale how PP interacts with the Ni-Cr surface passive film.

The studied metallic sample was a commercialized alloy based containing Ni (65 w%), Cr (22.5 w%) and Mo (9.5 w%) as predominant, major and minor crystalline phases respectively. The commercialized cylindrical monoliths were cut into cylinders of 1 and 10 mm in height and diameter respectively. These latter were mirror-polished, disinfected and dried. Then, the Ni-Cr samples were immersed without and with 0.05mol. L^{-1} PP in 25 mL of a saline solution (0.9 w% NaCl). During each essay, pH of 7.4 ± 0.2 and a temperature of 37.0 ± 0.5 °C were maintained. To follow the ions' release, Ni-Cr sample was taken from the solution after different immersion time ranging from 1 h to 7 days. After each period, the recuperated immersion solution is stored in hermitical bottles for ions' analysis.

Our results highlighted that immersion of NiCr alloy into a PP saline solution induces a lowering of the metal dissolution. The main effect of the presence of PP is the decrease of chromium dissolution, whereas no significant effect on dissolution of Ni is observed. The results suggest that PP decreases the dissolution of chromium from the oxide due to the adsorption of PP on the passive film. The XPS analysis reveals that three layers of PP are formed over the Cr_2O_3–rich passive film, which is the main constituent of the passive film [4]. Phenyl phosphate is consequently a good inhibitor of the corrosion of Ni-Cr alloys.

Keywords: Grafting, phenyl phosphate, Ni-Cr alloy, saline solution, XPS.

References:

[1] Bojinov M.; Fabricius G.; Kinnunen P.; Laitinen T., Ma¨kela K.; Saario T.; Sundholm G., Yliniemi K. Electrochim. Acta 2002, 47, 1697-1712.
[2] Ipeaiyeda A.R.1; Odola A.J. Water Sci. Technol. 2012, 66, 105-112.
[3] HancuV.;Comaneanu V-M.; Comani C.; Filipescu M-G.; Ghergic D-L.; Cotrut M-C. Rev. Chim. Dental Alloys. 2014, 65, 706–709.
[4] Naffati M., Zanna S., CornetteP., CostaD., Marcus P. Abderrabba M.M., Somrani S. Sulfur Silicon Relat. Elem. 193 (3) (2017) 185-191.

Electrical conductivity of $Ca_{10}(PO_4)_6F_2$ as single crystals and powders

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This work is part of the general framework of systematic studies of the physicochemical properties of apatites, in order to highlight their interest in the field of solid oxide fuel cells (SOFC).
The single crystals and powders of $Ca_{10}(PO_4)_6F_2$ fluorapatites have been synthesized by the solid-state reaction at high temperature. The samples were characterized by X-ray diffraction, Infrared spectroscopy and Raman scattering spectroscopy. X-ray diffraction patterns show that these materials crystallize in the hexagonal system with $P6_3/m$ as space group. Infrared and Raman spectra are reported and band assignments are made.
The complex impedance data indicate that relaxation phenomena are dependent on temperature. The bulk resistance decreases with increasing temperature, showing a typical negative temperature coefficient of resistance (NTCR). The ionic conductivity obeys the Arrhenius and the Jonscher laws.

Keywords: Fluorapatites, Electrical conductivity, Impedance, X-ray diffraction.

Direct and indirect electrochemical reduction prior to a biological treatment for metronidazole removal

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This work describes the electroreduction of metronidazole, a biorecalcitrant antibiotic. Metronidazole contains a nitro group that is known to reduce the biodegradability of the molecule. The reduction of this nitro group into amino compounds should increase the biodegradability of the compound allowing a rapid and efficient subsequent biological treatment.
Two electrochemical methods were tested to reduce the nitro group: a direct cathodic reduction in acidic medium and an indirect cathodic reduction using a catalyst, titanocene [1]. Electroreductions were performed in a home-made flow cell on a porous electrode of high specific area.
A total degradation of metronidazole was obtained, while the mineralization yields remained limited. Titanocene had a significant effect on the biodegradability trend, since indirect electrolysis seems to offer higher selectivity than direct electrolysis for the formation of more biodegradable by-products. The BOD_5 / COD ratio increased from 0.2 after direct electrolysis to 0.31 and 0.42 after reduction with 10 and 20 mg L^{-1} of titanocene, respectively [2].
To improve these encouraging results, the immobilization of titanocene on the electrode surface was investigated. Titanocene has been encapsulated into Nafion and analyzed by cyclic voltammetry and SEM analysis. The catalytic performances of the titanocene-modified electrodes tested for the reduction of metronidazole underline the efficiency of the process.

Keywords: Metronidazole, Direct Cathodic Reduction, indirect Cathodic Reduction, Catalyst, Titanocene-Modified Electrodes

References:

[1] D. Floner, L. Laglaine, C. Moinet*Electrochim. Acta* (1997)42,52.
[2] I. Saidi, I. Soutrel, D. Floner, F. Fourcade, N. Bellakhal, A. Amrane, F. Geneste, Journal of Hazardous Materials, 2014, 278, 172.

Electrochimical behavior of mild steel in different corrosive media: corrosionmonitoring

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This work focuses on the characterization of the electrochemical behavior of mild steel ASTM A915 in industrial and rain water where the effect of anions as Cl^-, SO_4^{--}, NO_3^- was studied and is a part of a study devoted to the corrosion resistance of this substrate. Polarization curves and electrochemical impedance measurements were obtained for different experimental conditions in bulk electrolyte. DRX and Raman spectroscopy were used to analyze the passive films. At the corrosion potential, the substrate was in the passive state and the corrosion process was controlled by the properties of the passive films formed during exposure to the aggressive media except in the presence of Cl^- anions. Indeed, for chloride concentrations between 0.01 and 0.5M the results show an increase of the corrosion current densities and simultaneously a decrease of the compactness of the corrosion layer "C=Q/Icorr". EIS diagrams exhibited two relaxation times. When $SO4^{--}$ were added to the electrolyte, it was found that the passive film was made mainly from Fe(II), Fe(OH)2, sulphate hydroxide with mixed valence Fe(II,III) or partially from green rust GR(SO_4^{--}). The obtained EIS diagrams show four relaxation times. The same results are obtained when the electrochemical tests were conducted in rain water. This let us to conclude that the electrochemical behavior of the mild steel in both waters is much closer to that obtained in sulphated medium.

Keywords: Mild steel, d.c. Polarization, EIS, Water, Raman Spectroscopy.

Inhibitory effectiveness of some benzimidazole towards mild steel corrosion in HCl solution

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In recent years, non-toxic benzimidazole and its derivatives compounds have received notable attention due to their inhibition characteristics for metallic corrosion and has been demonstrated that they are excellent inhibitors for metals in acidic solutions. The nitrogen atoms and the aromatic ring present in their molecular structure facilitate the adsorption of these compounds on metallic surface. According to the literature above-quoted, it is noted that 2-aryl-1-arylmethyl-1H-benzimidazole has not been studied as corrosion inhibitors in acidic medium with respect to the XC52 steel. In this context, we report the investigation on the corrosion inhibition performance of the biocompatible compounds derived from benzimidazole against corrosion of the XC52 steel in 1M hydrochloric acid solution. The inhibiting action of the 1-Benzyl-2-phényl-1H-benzimidazole (HB) and1-(4-Nitrobenzyl)-2-(4-nitrophényl)-1H-benzimidazole (NNHB) has been studied by electrochemical impedance spectroscopy (EIS) and potentiodynamic polarization. Results showed that the inhibition efficiency increased with the benzimidazole derivatives concentration of. Tafel polarization showed that both benzimidazole derivatives are mixed corrosion inhibitors. The adsorption of the benzimidazole derivatives decreases the double layer capacitance and increases the polarization resistance. The inhibitor performance depends strongly on the type of functional groups on benzene ring. It was found that the presence of the nitro group in the benzimidazole derivative (NNHB) reduces the adsorption of molecules on the surface; it is in the case with HB that the adsorption process is spontaneous and follows Langmuir adsorption isotherm. Calculation of the thermodynamic parameters such as $\Delta G°$, $\Delta H°$ and $\Delta S°$ shows that the inhibitive action of inhibitors is in the following order HB>NNHB. Scanning electron microscopy (SEM) is carried out to identify the surface morphology of mild steel both before and after the adsorption of benzimidazole derivatives molecules in order to confirm the electrochemical results.

Keywords:Inhibitors of corrosion, Benzimidazole, mild steel, Adsorption, Potentiodynamic polarization.

Investigation of the electrical properties of $Mg_6Al_2(OH)_{16}CO_3.4H_2O$ by complex impedance spectroscopy technique

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Nanocrystalline hydrotalcite phase material, with chemical formula $Mg_6Al_2(OH)_{16}CO_3.4H_2O$, was synthesized by co-precipitation method at constant pH = 9 and at room temperature. Its ac-conductivity was investigated using complex impedance spectroscopy technique in the frequency range 5 Hz - 13 MHz. The temperature interval explored range from 733K to 913K.

In Figure 1 are shown the typical complex impedance spectra (Nyquist plots: -Z" vs Z') of the synthesized hydrotalcite. The ac-conductivity observed is attributed to the mixed oxide phases (MgO and Al_2O_3) produced from hydrotalcite at 733K. From 833K, the ac-conductivity increases simultaneously with the appearance of the spinal phase $MgAl_2O_4$.

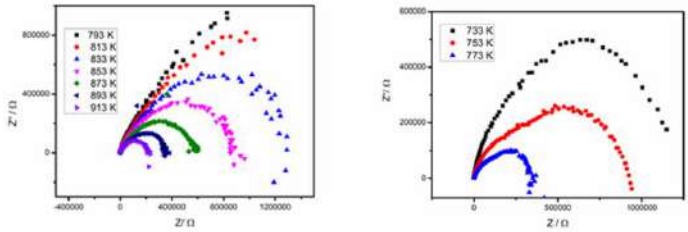

Figure 1: Nyquist plots at different temperature.

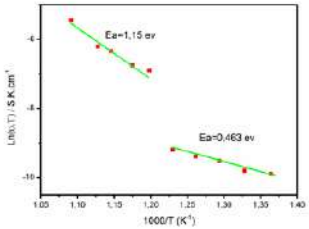

Figure 2: Arrhenius plot

Figure 2 shows the Arrhenius plot of Ln(σT) vs1000/T. Two different separate regions can be observed at temperature 833 K. The activation energies calculated from Arrhenius plots were found equal to 0,463 eV in the temperature range of 733-813 K and 1,15 eV in the temperature range of 833-913 K.

Keyword: Hydrotalcite, Ac-conductivity, Complex Impedance spectroscopy.

Antioxidant activity of arbutus plant extract and their corrosion inhibiting properties of carbon steel in a 3% NaCl solution

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Plants are sources of naturally occurring compounds~~,~~ with complex molecular structure~~s~~ and having different chemical, biological, and physical properties. Plant products are inexpensive, renewable, and readily available. The naturally occurring compounds are used in different fields of application because of their biocompatibility, cost effective, and abundant availability. These advantages justify the use of extracts plants as corrosion inhibitors for metals, commonly known as green corrosion inhibitors [1].
In this study, the corrosion inhibition of arbutus tree extracts of carbon steel in a 3% NaCl solution was performed using potentiodynamic polarization and electrochemical impedance spectroscopy (EIS). The leaves extract with higher polyphenols and flavonoids amounts show a strong antioxidant activity. Otherwise, leaves extract of different solvents (methanol/ water (80/20, v/ v) and MeOH/ water, acidified 1%) put in evidence high inhibition efficiency of 90.4% and 92.7%. EIS results showed a maximum inhibition efficiency (92.4%) for an inhibitor concentration of 100 ppm. The polarization curves indicated that the plant extract is an anodic inhibitor.

Keywords: Carbon steel; Arbutus; Polyphénols, Antioxidant activity; EIS; NaCl solution; Polarization

Reference

[1] Akaranta, A., Adindu,P.(2013). Inhibition action of some plant extracts on the corrosion of steel in acidic media. Corrosion science 48(9): 2765-2779.

Synthesis, characterization, optical and electrical properties of $HLnP_2O_7 \cdot xH_2O \cdot yNH_3$ and $Gd_2P_4O_{13}$ (Ln = Gd, Ho)

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New gadolinium diphosphate $[HGdP_2O_7 \cdot 2H_2O] \cdot NH_3$ and $HHoP_2O_7 \cdot 3H_2O$ were synthesized by the slow evaporation method at room temperature. The obtained crystals, with prismatic morphology, were characterized by means of X-ray diffraction (XRD) and infrared (IR) spectroscopy. The results showed a high purity phases.
The calcination of $[HGdP_2O_7 \cdot 2H_2O] \cdot NH_3$ at 850°C and $HHoP_2O_7 \cdot 3H_2O$ at 300°C in a static air furnace, allowed us to obtain respectively the tetraphosphate $Gd_2P_4O_{13}$ and the anhydrous diphosphate $HHoP_2O_7$. X-ray powder diffraction and infrared spectroscopy were used to identify these materials.
The electrical properties of $HHoP_2O_7$ and $Gd_2P_4O_{13}$ were investigated through impedance complex analysis. Resistance, conductivity values and conduction mechanism within the materials are determined and discussed. Activation energies of 0.405 and 1.16 eV were deduced from the Arrhenius plots for $HHoP_2O_7$ and $Gd_2P_4O_{13}$ respectively. These materials have a semiconductor ionic character and can be considered as good candidates in the storage energy application.

Keywords: Gadolinium diphosphate, Electrical properties, Semiconductor, Activation Energy.

Novel electrochemical route to Benzimidazole dimer as deposit on platinum surface

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Benzimidazole dimers are recognized as nucleic acid minor groove binding agents, they are strongly candidate to act via DNA or RNA grooves [1,2]. 3-(4-fluorophenyl)-2-methyl-[1,2a] benzimidazolo-1,3,5-triazin-4-thione was synthesized and electrochemically oxidized in an acetonitrile solution by means of cyclic voltammetry and controlled potential electrolysis on platinum, leading to its corresponding dimer through the anodic oxidation as a deposit material. In the voltammetric study, three irreversible oxidation waves were observed. When sweeping the potential repetitively about the first anodic one, a growing film was deposited on the platinum disk. With cupper as anode, an adherent coverage by the oxidation product of the benzimidazole derivative was immediately observed, preventing the dissolution of the metallic electrode. On the preparative scale, the electrolysis at a potential located on the first wave yielded similarly to a deposit, but in addition to several oxidation products, in soluble and insoluble forms. The deposit was characterized by LC-MS and ^{1}H NMR as a dimer formed via one electron transfer followed by a C-S linkage, an intra molecular proton transfer, a C-C coupling and an elimination of two fluorine anions. The results were rationalized on the basis of quantum-chemical calculations, using the PCM approach with the density functional theory.

Keywords: Benzimidazole, Cyclic Voltammetry, Electrolysis, Electrodeposition, Density functional theory, PCM.

References:

[1] P.G. Baraldi, A. Bovero, F. Fruttarolo, et al., Med. Res. Rev. 24 (2004) 475–528.
[2] M. Singh, V. Tandon, Eur. J. Med. Chem. 46 (2011) 659–669.

Joint investigations of the electrochemical behavior and antibacterial activity of a Cadmium Coordination Polymer Based on Phosphate Clusters

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Cadmium complexes have shown higher activity in comparison with the ligand against microorganisms [1]. In one of the possible mechanism action, the capacity of ion metal species to acquire electrons from donors is expected in the oxidative stress damaging microorganism's cellular proteins, lipids and DNA [2]. Their toxicity relates with the aerobic respiration process producing partially reduced forms of the molecular oxygen [3]. It was also claimed that a noticeable selective activity of the metal complexes containing oxygen or nitrogen donor ligand was seen in comparison to their metal free ligands [4]. Thereabout, the knowledge of the electrochemical behavior of these materials might be attractive in order to design the properties that regulate its antibacterial activity. On the basis of the aforementioned points, we carried out further studies on supramolecular reactions of Cd(II) with the hexafunctional linker $P_6O_{18}^{6-}$, that is of strong coordinating ability and suitable hydrogen bond acceptor, in the presence of template homopiperazine. In doing so, we discovered a novel 1D coordination polymer, viz $\{(C_5H_{14}N_2)_2[Cd((P_6O_{18})(H_2O)_2)].6H_2O\}_n$. By means of cyclic voltammetry at a gold electrode, we will report first a comparative study of its cathodic reduction and anodic oxidation to those of its corresponding free ligand, cation and counter ion. Then its potency as in vitro antibacterial agents will provide a basis of discussion.

Keywords: Cyclohexaphosphate, Cadmium Coordination Polymer, antibacterial activity, Cyclic Voltammetry.

References

[1] M. M. Al-Mogren, A. N. M. AAlaghaz, Int. J. Electrochem. Sci., 8, (2013) 8669.
[2] J.A. Lemire, J. J. Harrison, R. J. Turner, Nat. Rev. Microbiol., 11 (2013), 371.
[3] L. M. Gaetke, C. K. Chow. Toxicology, 189 (2003) 147.
[4] M. Patel, M. Chhasatia, P. Parmar., Eur. J. Med. Chem., 45, (2010) 439.

Application of experimental design to the electro-Fenton treatment of Bismarck Brown Y

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The removal of the synthetic dye Bismarck Brown Y (BBY) has been investigated by electro-Fenton process, using a RVC cathode to electrogenerate in situ hydrogen peroxide and regenerate ferrous ions as catalyst. The optimization of the process has been performed using Doehlert designs and the BBY removal, after 30 min, has been used as analytical response. Three variables (i.e. iron concentration, applied current and initial dye content) have been studied as factors in the optimization of BBY degradation. The experimental results showed

that BBY was almost completely removed by the reaction with •OH radicals generated from electrochemically assisted Fenton's reaction, and the decay kinetic always follows a pseudo-first-order reaction.

The Doehlert matrix has proved to be a good design for response surface methodology because it permits to estimate the influence of the parameters of the quadratic model and to find the optimum conditions for BBY removal. In particular, the analysis of the Doehlert design indicated that ion Fe2+ concentration and applied current have a positive response on the process, and the maximum advantage is reached with the combined effect of these two parameters. Optimum BBY degradation was achieved by applying a current of 157 mA, with 0.25 mM Fe2+ and initial BBY concentration of 118.4 mg/L, and in these conditions BBY removal was 97% in 30 min and it was almost completely mineralized in 90 min.

Keywords: Response surface methodology, Doehlert design, Electro-Fenton, Bismarck Brown Y, RVC cathode.

Complete removal of poly R-478 synthetic dye from water using new electro-fenton oxidation catalyzed by pyrite as heterogeneous catalyst

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Diversity and rapidly multiplication of the pollutantsincite as to improve the conventional treatments wastewatermethods. One of the bottlenecks often faced is the presence into wastewater of organic pollutants with complex structures that requests the design of efficient processes. Thus, this work investigates the removal of polyvinylamine sulfonate anthrapyridone (PSA) dye which complex structure makes difficult its degradation by conventional technologies. For that, a heterogeneous oxidative process using pyrite as sustainable catalyst was designed. Initially, the performance of the system BBD-carbon felt as anode and cathode, respectively for the production of H2O2 was determined in comparison with system boron-doped diamondnickel foam. The carbon felt electrode provided the highest oxidant production, and it was selected for the treatment of the polymeric dye. Several oxidative processes were evaluated, and the best degradation levels were obtained by application of electro-Fenton-pyrite process. In addition, it was determined that dye removal followed a kinetic model of pseudo-first-order achieving the highest efficiency by operation at optimumdosage of pyrite 2 g/L and 200 mA of current intensity. Depending on the optimal experimental conditions, these values lead to a nearly complete mineralization (total organic carbon removal of95%) after 6 h. Furthermore, the reusability of pyrite was evaluated, by removal of PSA in four cycles.

Keywords : Heterogeneous electro-Fenton . Hydrogen peroxide . Carbon felt . Polyvinylamine sulfonate anthrapyridone, Pyrite, reusability.