59th Annual Meeting of the International Society of Electrochemistry

September 7 to 12, 2008
Seville, Spain
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Electrochemistry Down to the Molecular Level:
Interfacial Science for Life and Technology

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Characterization of electrodeposited Ni-Mo-O alloy powders

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Marzena Kaniewska (Warsaw University, Department of Chemistry, Warsaw, Poland), Marek Trojanowicz
Enantioselectivity of Potentiometric Response of Conducting Polymer Sensors

s10-P-041
Ghasem Karim-Nezhad (Department of Chemistry, Khoy, Iran (Islamic Republic of)), Mohammad Hasanzadeh, Lotfali Saghatforoush, Nasrin Shadjo
Study of the Electro-Catalytic Oxidation of Some Monosaccharide on a Cobalt Hydroxide Modified Glassy Carbon Electrode in Alkaline Solution

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Ioannis Katsounaros (Department of Chemical Engineering, Aristotle University of Thessaloniki, Thessaloniki, Greece), Maria Dortsiou, Christos Polatides
On the Mechanism of the Electrochemical Reduction of Nitrate

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Ioannis Katsounaros (Department of Chemical Engineering, Aristotle University of Thessaloniki, Thessaloniki, Greece), Maria Dortsiou, Christos Polatides
Electrochemical Destruction of Nitrate and Nitrite from Low Level Radioactive Wastes

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Kensuke Kuroda (Dept. of Mater. Sci. & Eng., Nagoya Univ., Nagoya, Japan), Ryoichi Ichino, Ikki Kawai, Masazumi Okido
Osteoconductivity of TiO$_2$ coatings on the Ti substrate with micron-level surface roughness

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Marcos R. V. Lanza (Universidade São Francisco, Bragança Paulista, Brazil), André A. G. F. Beati, Fabio Boin, Regina C. A. Fernandes, Joaquim G. Oliveira, Ana Paula A. Sá
Ametryn Oxidation via Electro-fenton using Gas Diffusion Electrodes

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María Lasheras-Zubiate (Departamento de Química y Edafología / Universidad de Navarra, Pamplona, Spain), José María Fernández, Íñigo Navarro-Blasco
Voltammetric evaluation of chitosan as an effective complexing ligand for the removal of toxic heavy metals

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Chong Yong Lee (School of Chemistry, Monash University., Clayton, Melbourne, Australia), Alan M Bond, Si-Xuan Guo, Keith B Oldham
Probing Heterogeneity on Highly Ordered Pyrolytic Graphite Electrode Surface Using Large Amplitude Fourier Transform ac Voltammetry

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Grzegorz Lisak (Laboratory of Analytical Chemistry, Åbo Akademi University, Åbo, Finland), Johan Bobacka, Ewa Grygolowicz - Pawlak, Andrzej Lewenstam, Elżbieta Malinowska, Marta Mazurkiewicz, Tomasz Sokalski
Polyacrylate-based lead (II) ion-selective electrodes

s10-P-049
Javier Llanos (Chemical Engineering Department, Faculty of Chemical Sciences, University of Castilla-La Mancha, Ciudad Real, Spain), Pablo Cañizares, Ángel Pérez, Manuel A. Rodrigo
Electrochemical Approach to the Regeneration of Bonding Agents Used in Polymer Supported Ultrafiltration (PSU) Processes

s10-P-050
Ana Lopes (Department of Chemistry, University of Beira Interior, Covilhã, Portugal), Lurdes Ciríaco, Isolina Gonçalves, Sandra Sobreira
Effect of a Redox Mediator on Azo Dyes Decolorization
Voltammetric evaluation of chitosan as an effective complexing ligand for the removal of toxic heavy metals

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Chitosan is the product of deacetylation of chitin, a natural homopolymer of β-(1-4) linked N-acetyl-D-glucosamine repeating units. Chitin is known as the second most abundant biopolymer, after cellulose, among the biopolymers found in nature. It is abundant as part of crustaceans, molluscs, insects, fungi, and related organisms. The ability to strongly complex with heavy metal ions is one of the key features of chitosan. Several applications have been proposed for removing toxic metals by complexation in water purification.

The aim of this study is to evaluate de complexation of toxic heavy metals such as Pb, Zn, Cd and Cu by three commercial chitosans with different molecular weights. For this purpose, the complexation capacity of chitosan was evaluated through competitive deposit of the metals onto the HMDE from ligand-containing solutions and subsequent voltammetric measurement of the anodic stripping signal. Chitosan and spiked metal solutions were dissolved in an acetic-acetate buffer solution (pH=3,5). The complexation capacity was also evaluated at different concentrations of chitosans.

Up to now, preliminary results indicate that chitosan complexes more effectively Zn than Pb, probably due to the lower size of Zn which allows its inclusion into the available linking sites of chitosan. Besides, Zn stripping peak shows a marked decrease in its intensity and a displacement towards less negative potentials, proving the high affinity of chitosan for Zn.

The higher the molecular weight of chitosan, the larger the binding capacity observed for both metals, probably due to the fact that a longer chitosan chain involves a larger number of free available amino groups. Diluted chitosan solutions showed an increase of complexation capacity irrespective of the assayed molecular weight. This finding could be ascribed to the diminishing of steric hindrances as well as to the breaking of stabilizing hydrogen bonds within the structure of the chitosan molecule. As a consequence, metals readily bind to the polymer.

Future developments of these studies will focus on the retention of this type of stable complexes within an inert cement matrix as a way to reduce toxicity from waste.
INTRODUCTION

Chitosan is the product of deacetylation of Chitin, a natural homopolymer of 5-(1-4) linked N-acetyl-D-glucosamine repeating units. Chitin is known as the second most abundant biopolymer, after cellulose, among the biopolymers found in nature. It is abundant as part of crustaceans, molluscs, insects, fungi and related organisms. The ability to strongly complex with heavy metal ions is one of the key features of Chitosan.

Several applications have been proposed for removing toxic metals by complexation in water purification. The aim of this study is to evaluate the complexation of toxic heavy metals such as Pb, Zn and Cd by three commercial Chitosans with different molecular weights. The complexation capacity was also evaluated at different concentrations of Chitosans.

MATERIAL AND METHODS

The complexation capacity of Chitosan was evaluated through competitive deposit of the metals onto the HMDE from ligand-containing solutions and subsequent voltammetric measurement of the anodic stripping signal. Chitosan (Sigma) and spiked metal solutions (Merck) were dissolved in an acetic-acetate buffer solution (pH=3.5).

RESULTS AND DISCUSSION

Chitosan is able to chelate the increasing amounts of metals added: two slopes are recorded, the lowest one corresponding to complexed metal and the highest one to free metal for all the Chitosans at different concentrations (Figure 1).

It can be observed that Chitosan complexes more effectively Zn than Pb and Cd, probably due to the lower size of Zn which allows its inclusion into the available linking sites of Chitosan. Besides, Zn stripping peak shows a marked decrease in its intensity and a displacement towards less negative potentials, proving the high affinity of Chitosan for Zn.

The higher the molecular weight of Chitosan, the larger the binding capacity observed for both metals, due to the fact that a longer Chitosan chain involves a larger number of free available amino groups (Table I). Diluted Chitosan solutions showed an increase of complexation capacity irrespective of the assayed molecular weight (Table II). This finding could be ascribed to the diminishing of steric hindrances as well as to the breaking of stabilizing hydrogen bonds within the structure of the Chitosan molecule. As a consequence, metals readily bind to the polymer.

CONCLUSIONS

Results indicate that chitosan complexes effectively Zn, Pb and Cd, showing the maximum retention capacity for Zn, probably due to the lower size of Zn which allows its inclusion into the available linking sites of Chitosan.

Molecular weight and dilution of Chitosan have a great importance in complexation capacity. The higher the molecular weight of Chitosan, the larger the binding capacity observed for both metals. Diluted Chitosan solutions showed an increase of complexation capacity due to a decrease of the steric hindrances of the polymer.

Future developments of these studies will focus on retention of this type of stable complexes within an inert cement matrix as a way to reduce toxicity from waste.

ACKNOWLEDGEMENTS

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REFERENCES


