

**VOLTAMMETRY BEHAVIOR OF CADMIUM (II) ION AT THE MERCURY  
ELECTRODE IN THE PRESENCE OF GLUTATHIONE AND THIOGLYCOLIC  
ACID**

**By**

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**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia in  
Fulfillment of the Requirement for the Degree of Master of Science**

**January 2006**

## **DEDICATION**

*For my beloved parents and family in Libya*

Abstract of the thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

**Voltammetry behavior of Cadmium (II) ion at the mercury Electrode in the Presence of Glutathione and Thioglycolic acid**

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**January 2006**

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Voltammetric behaviors of cadmium (II) ion in the presence of a ligand with sulphur bearing group, such as Glutathione  $\{(COO^-)(NH_3^+(CH_2)_2CONHCH(CH_2SH)CONH(CH_2)(COO^-)\}$  and Thioglycolic acid  $(HSCH_2COO^-)$  were studied using mainly Osteryoung square wave voltammetry (OSWV) and Cyclic voltammetry (CV) at a mercury electrode. The coordination chemistry of reduced glutathione (GSH) is of great importance as it acts as excellent model system for the binding of metal ions.

In this study, it was observed that an addition of glutathione as ligand to solution containing Cd(II) with sulphate as supporting electrolyte caused an increase in the reduction current of Cd(II) by several factors and also with a slight cathodic shift in the reduction peak potential of Cd(II). Further assessment of the chemical and physical

conditions that may favour optimum current enhancement was done by studying the effect of varying pH, supporting electrolyte, concentration of ligand and metal ion, interfering ions and scan rate. The presence of 1-3 mM glutathione, a weakly complexing supporting electrolyte at pH 4-5 caused a 2-3 fold increase in the reduction current of Cd(II) and a slight negative shift in peak position . The presence of 1-5mM TGA at pH5.3 caused 1-2 fold increase in the reduction current of Cd(II) and a slight negative shift in peak position.

The current enhancement observed in different electrolytic media varied in the following order: sulphate >nitrate> perchlorate. The presence of other metal ion such as Cr(III) or Co(III) appear to cause further increase in the reduction current of the Cd(II)-glutathione peak while the presence of Ni(II) was found to suppress the enhanced peak current.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains.

**SIFAT VOLTAMETRI BAGI ION KADMIUM (II) PADA ELEKTROD  
MERKURI DENGAN KEHADIRAN GLUTATION DAN ASID TIOGLIKOLIK**

Oleh

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Tingkahtlaku voltammetri bagi ion kadmium (II) dalam kehadiran ligan yang mempunyai kumpulan sulfur seperti gultathione  $\{(COO^-)(NH_3^+(CH_2)_2CONHCH(CH_2SH)CONH(CH_2)(COO^-))\}$  dan Thioglycolic acid  $(HSCH_2COO^-)$  telah dikaji dengan menggunakan teknik voltammetri gelombang segiempat sama Osteryoung (OSWV) dan voltammetri siklik (CV) pada elektrod merkuri. Koordinasi kimia glutathione (GSH) terturun adalah penting kerana ia boleh menjadi satu model dalam pergabungan dengan ion logam.

Dalam kajian ini, didapati dengan penambahan glutathione sebagai ligan kepada larutan yang mengandungi ion Cd (II) bersama sulfat sebagai elektrolit sokongan menyebabkan peningkatan dalam arus penurunan bagi Cd(II) dengan beberapa faktor, juga dengan sedikit anjakan kedudukan katodik pada puncak keupayaan penurunan bagi Cd (II). Penilaian lanjut mengenai keadaan kimia dan fizikal yang cenderung terhadap penambahan arus optima telah dilakukan dengan mengkaji kesan-kesan perubahan pH,

kepekatan ion logam dan ligan, ion gangguan serta kadar imbasan. Kehadiran 1-3mM glutathione di dalam kompleks penyokong elektrolit yang lemah pada pH 4-5 menyebabkan peningkatan arus penurunan bagi Cd (II) sebanyak 2-3 kali ganda serta sedikit anjakan kedudukan keupayaannya ke arah negatif. Kehadiran 1-5 mM TGA pada pH 5.3 juga menyebabkan peningkatan arus penurunan sebanyak 1-2 kali ganda dan sedikit anjakan negatif pada puncak Cd (II).

Penambahan arus di dalam media elektrolit yang berlainan berubah mengikut tertib berikut: sulfat>nitrat>perklorat. Kehadiran ion logam lain seperti Cr (III) atau Co (III) menyebabkan peningkatan arus terturun bagi puncak Cd(II)-glutathione manakala kehadiran ion Ni(II) menyebabkan penurunan bagi arus terturun.

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*In The Name of ALLAH, the Most Merciful and Most Beneficent*

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I certify that an Examination Committee met on 03/01/2006 to conduct the final examination of Mohammed Zidan on his Master of Science thesis entitled “Volumetry behavior of Cadmium (II) ion at the mercury Electrode in the presence of Glutathione” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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## **DECLARATION**

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declared that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

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**MOHAMMED ZIDAN**

Date:

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