



UNIVERSITI PUTRA MALAYSIA

**ELECTROCHEMICAL STUDY OF MAGNESIUM DIBORIDE
MODIFIED ELECTRODE**

MOHD FARHAN BIN YUSRI

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**ELECTROCHEMICAL STUDY OF MAGNESIUM DIBORIDE
MODIFIED ELECTRODE**



By

MOHD FARHAN BIN YUSRI

Thesis Submitted to the School of Graduate Studies, University Putra Malaysia,
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**ELECTROCHEMICAL STUDY OF MAGNESIUM DIBORIDE
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Chair : Assoc. Prof. Tan Wee Tee, PhD

Faculty : Faculty of Science

Use of a glassy carbon (GC) modified by adhered microparticles of MgB_2 mediates the reduction process of $\text{Fe}(\text{CN})_6^{3-}$ during cyclic voltammetry. Potential at reduction peak was observed to shift slightly from 0.20 to 0.23 V and current is significantly enhanced by about two folds. The sensitivity under conditions of cyclic voltammetry is significantly dependent on pH, electrolyte and scan rate. The result of scanning electron micrograph of MgB_2 obtained before and after electrolysis show the size of the MgB_2 microparticles increased slightly to the size ranging from 2 - 5.5 μm attributing to the hydration effect and/or incorporation of some ionic species into the crystal lattices of MgB_2 . Interestingly, redox reaction of Fe(III) solution using modified GC electrode remain constant even after 15 cycle reflecting the usability of the MgB_2 film attached to the GC electrode surface.

Use of a lithium doped magnesium diboride modified glassy carbon electrode enhance the oxidation current of ascorbic acid during cyclic voltammetry compare to bare GC and MgB_2 modified electrode. Peak potential was observed to shift slightly from around 0.40 to 0.25 V and current is significantly enhanced by about two folds. The sensitivity under conditions of cyclic voltammetry is significantly dependent on pH, temperature, electrolyte and scan rate. The result of scanning electron micrograph of MgB_2 with Li^+ doped obtained before and after electrolysis show the size increased slightly to the size ranging from 0.5 - 1.3 μm to 3 - 7 μm attributing to the hydration effect and/or incorporation of some ionic species into the crystal lattices of MgB_2 .

The oxidation current of ascorbic acid decreased sharply after the first cycle and become stable with minor decreases after second cycle. The recovery values of $99.0 \pm 0.4\%$ was obtained after the addition of 0.5 mM ascorbic acid into rose flavour syrup while recovery of $99.2 \pm 0.1\%$ was obtained after the addition of 0.05 mM ascorbic acid into rose syrup.

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

**KAJIAN ELEKTROKIMIA MODIFIKASI ELEKTRODE
MAGNESIUM DIBORIDA**

Oleh

MOHD FARHAN BIN YUSRI

Mac 2011

Pengerusi : Prof. Madya Tan Wee Tee, PhD

Fakulti : Sains

Elektrod karbon kaca (KK) diubahsuai dengan perantara mikropartikel MgB_2 proses penurunan $\text{Fe}(\text{CN})_6^{3-}$ dalam kitaran voltammetri. Puncak potensi yang diperoleh mengalami sedikit pergeseran daripada 0.20 ke 0.23 V dan arus secara signifikan meningkat kira-kira dua kali ganda. Kepekaan dalam keadaan kitaran voltammetri secara signifikan bergantung pada pH, elektrolit dan kadar kitaran. Keputusan imbasan mikrograf elektron MgB_2 diperolehi sebelum dan selepas elektrolisis menunjukkan saiz sedikit peningkatan dengan saiz berkisar 2-5.5 μm kesan penghidratan dan/atau penggabungan beberapa spesies ion ke dalam kekisi kristal MgB_2 . Menariknya, reaksi redoks larutan Fe(III) menggunakan elektrod ini tetap konsisten setelah 15 kitaran mencerminkan kegunaan dari filem MgB_2 melekat pada permukaan elektrod KK.

Lekatan lithium pada modifikasi KK yang diubahsuai dengan MgB_2 meningkatkan arus pengoksidaan paling tinggi pada kitaran voltammetri asid askorbik berbanding dengan elektrod KK tanpa modifikasi dan elektrod karbon kaca (KK) diubahsuai dengan mikropartikel MgB_2 . Puncak potensi mengalami sedikit pergeseran dari 0.40 ke 0.25 V dan arus secara signifikan meningkat kira-kira dua kali ganda. Kepekaan dalam keadaan kitaran voltammetri secara signifikan bergantung pada pH, suhu, elektrolit dan kadar kitaran. Keputusan imbasan mikrograf elektron MgB_2 dengan lekatan lithium diperolehi sebelum dan selepas elektrolisis menunjukkan saiz sedikit peningkatan dengan saiz berkisar antara 0.5 - 1.3 μm ke 3 - 7 μm kesan penghidratan dan/atau penggabungan beberapa spesies ion ke dalam kekisi kristal MgB_2 .

Puncak pengoksidaan asid askorbik turun mendadak selepas kitaran pertama dan menjadi stabil selepas kitaran kedua. Penentuan kandungan asid askorbik ditentukan dengan nilai $99.0 \pm 0.4\%$ diperolehi untuk sampel air sirap yang ditambah kepekatan asid askorbik 0.5 mM manakala $99.2 \pm 0.1\%$ diperolehi daripada penambahan kepekatan asid askorbik 0.05 mM ke dalam sampel sirap.

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I certify that a Thesis Examination Committee has met on **2011** to conduct the final examination of **Mohd Farhan bin Yusri** on his thesis entitled **Electrochemical Study of Magnesium Diboride Modified Electrode** in accordance with the Universities and University Colleges Act 1971 and the Constitution of the University Putra Malaysia [P.U. (A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science

Members of the Thesis Examination Committee were as follows:

Tan Yen Ping, PhD
Faculty of Science
University Putra Malaysia
(Chairman)

Anuar Kassim, PhD
Professor
Faculty of Science
University Putra Malaysia
(Internal Examiner)

Nor Azah Yusof, PhD
Associate Professor
Faculty of Science
University Putra Malaysia
(Internal Examiner)

Sulaiman Ab. Ghani, PhD
Associate Professor
School of Chemistry
University Sains Malaysia
Malaysia
(External Examiner)

PROF. DR. SHAMSUDDIN SULAIMAN, PhD
School of Graduate Studies
University Putra Malaysia

Date:

This thesis was submitted to the Senate of University Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

Assoc. Prof. Tan Wee Tee, PhD

Associate Professor
Faculty of Science
Universiti Putra Malaysia
(Chairman)

Zulkarnain bin Zainal, PhD

Professor
Faculty of Science
Universiti Putra Malaysia
(Member)

Chen Soo Kien, PhD

Senior Lecturer
Faculty of Science
Universiti Putra Malaysia
(Member)

HASANAH MOHD GHAZALI, PhD

Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

MOHD FARHAN BIN YUSRI

Date:

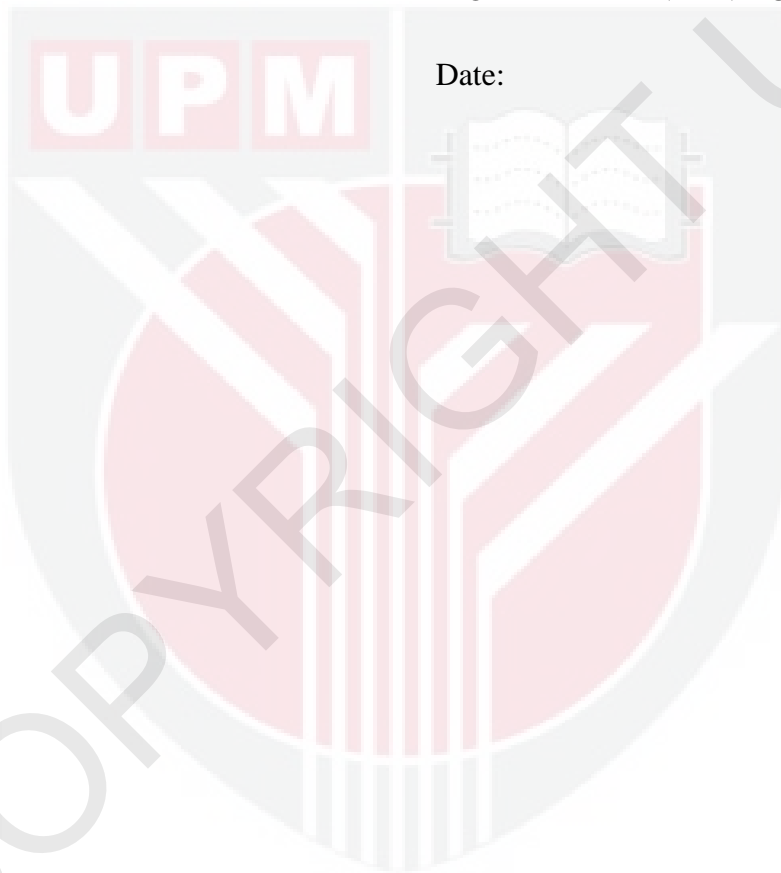


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