

**ELECTROCHEMICAL STUDIES**  
**OF**  
**METAL DEPOSITION AND SURFACE CHIRALITY**  
**AT**  
**WELL-DEFINED PLATINUM SINGLE CRYSTAL**  
**ELECTRODES**

**A thesis submitted to the**  
**University of Wales**  
**for the degree of**  
**Philosophiae Doctor**

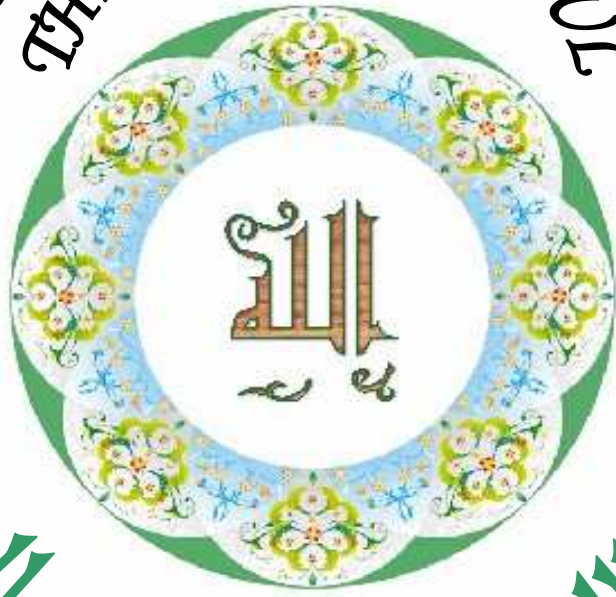
**By**

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**October 2002**

IN THE NAME OF ALLAH  
THE MOST GRACIOUS  
THE MOST MERCIFUL



بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

## ABSTRACT

In this investigation the concept of chirality has been explored as it applies to metal surfaces, and attempts have been made to exploit that chirality to achieve enantio-selective catalytic reaction. Cyclic voltammetry has been used to determine the morphology of flat, stepped, and kinked surfaces of platinum single crystal electrodes and to determine the growth modes of bismuth, gold and silver deposited on these well-defined platinum surfaces. Kink sites which occur at the junction of monoatomic steps are chiral, and this is evidenced by the electro-oxidation of D- or L-glucose which gives rise to enantioselectivity. Selective adsorption of bismuth, gold, or silver in these kink sites leads to a degradation of that enantioselectivity, the fine detail of the effects being different in each case and interpretable in terms of the established growth modes. The adsorption of a graded series of simple and more complex chiral organic molecules on a wide range of chiral platinum surfaces has revealed other systems where reaction or specific adsorption effects occur, but no enantioselective responses were obtained. Clear directions have been established for future studies of molecule-catalyst interactions involving chirality simultaneously present in the adsorbent and in the adsorbate.

## PUBLICATIONS

1. **The Characterisation of Supported Platinum Nanoparticles on Carbon Used for Enantioselective Hydrogenation: A Combined Electrochemical-STM Approach**

Gary A. Attard, Ahmad Ahmadi, , David J. Jenkins, **Omar A. Hazzazi**, Peter B. Wells, Ken G. Griffin, Peter Johnston, Jennifer E. Gillies.

**CHEMPHYSICHEM 4 (2) : 123-130 FEB 17 (2003).**

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**Journal of Molecular Catalysis A : Chemical 216 (2004).**

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3. **On the Global and Local Values of the Potential of Zero Total Charge at Well-Defined Platinum Surface : Stepped and Adatom Modified Surfaces**

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4. **Electrochemical Characterisation of Gold on Pt{hkl} for Ethanol Electrocatalysis**

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**DEDICATION**

*To:*

- *My 99 year old grandmother, Sahla,*
- *My parents, Abdullah and Fatimah,*
- *My very patient wife, Samiyah,*
- *My Children: Abdulrahman, Sarah, Abeer, Abdullah, Al-Jawhara and Nouf.*
- *My father's wives,*
- *My brothers and sisters,*
- *All the staff at Umm Al-Qura University at Saudi Arabia especially my best sincere friend, Dr. Matter Alossaimi,*
- *All Muslims around the world who sincerely want to show others the real picture of the Merciful Religion: Islam.*

**DECLARATION**

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

Signed.....Omar A. Hazzazi.....(candidate)

Date.....Monday 21<sup>st</sup> October 2002.....

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This thesis is the result of my own investigations, except where otherwise stated. Other sources are acknowledged by footnotes giving explicit references. A bibliography is appended.

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