

**PREPARATION AND CHARACTERIZATION OF PLATINUM-
BASED TERNARY CATALYSTS ON CARBON SUPPORT
FOR USE IN A PROTON EXCHANGE
MEMBRANE FUEL CELL**

SIWAT THUNGPRASERT

**DOCTOR OF PHILOSOPHY
IN CHEMISTRY**

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

Copyright © by Chiang Mai University
All rights reserved
THE GRADUATE SCHOOL
CHIANG MAI UNIVERSITY
AUGUST 2012

**PREPARATION AND CHARACTERIZATION OF PLATINUM-
BASED TERNARY CATALYSTS ON CARBON SUPPORT
FOR USE IN A PROTON EXCHANGE
MEMBRANE FUEL CELL**

SIWAT THUNGPRASERT

**A THESIS SUBMITTED TO THE GRADUATE SCHOOL IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
IN CHEMISTRY**

**THE GRADUATE SCHOOL
CHIANG MAI UNIVERSITY**

AUGUST 2012

PREPARATION AND CHARACTERIZATION OF PLATINUM-BASED
TERNARY CATALYSTS ON CARBON SUPPORT FOR USE IN
A PROTON EXCHANGE MEMBRANE FUEL CELL

SIWAT THUNGPRASERT

THIS THESIS HAS BEEN APPROVED
TO BE A PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY
IN CHEMISTRY

EXAMINING COMMITTEE

Aphiruk Chaisena
.....CHAIRPERSON
Asst. Prof. Dr. Aphiruk Chaisena

Thapanee Sarakonsri
.....MEMBER
Asst. Prof. Dr. Thapanee Sarakonsri

J. Pumchusak
.....MEMBER
Asst. Prof. Dr. Jantrawan Pumchusak

Chamnan Randorn
.....MEMBER
Dr. Chamnan Randorn

K. Panyawudho
.....MEMBER
Dr. Konlayutt Panyawudho

THESIS ADVISORY COMMITTEE

Thapanee Sarakonsri
.....ADVISOR
Asst. Prof. Dr. Thapanee Sarakonsri

Apinun Rujiwatra
.....CO-ADVISOR
Assoc. Prof. Dr. Apinun Rujiwatra

Titipun Thongtem
.....CO-ADVISOR
Assoc. Prof. Titipun Thongtem

1 August 2012

© Copyright by Chiang Mai University

ACKNOWLEDGEMENTS

I would like to thank my supervisor, Asst. Prof. Dr. Thapanee Sarakonsri, for my great opportunities, supervisions, valuable suggestions and all supports. She has given me throughout my Ph.D. period. I would like to special thank to the thesis committee members, Assoc. Prof. Dr. Apinpus Rujiwatra and Assoc. Prof. Titipun Thongtem, and especially, the examining committee, Asst. Prof. Dr. Aphiruk Chaisena, Asst. Prof. Dr. Jantrawan Pumchusak, Dr. Chamnan Random, and Dr. Konlayutt Panyawudho for their helpful advices, comments and suggestions my thesis.

This research was supported by grant under the program Strategic Scholarships for Frontier Research Network for the Ph.D. Program Thai Doctoral degree from the Office of the Higher Education Commission (OHEC), Thailand (to R. Choommongkol) and additional support from the Center for Innovation in Chemistry (PERCH-CIC).

I would like to thank all helps and supports from officers and technical staffs of Department of Chemistry, Department of Geology, and Electron Microscopy Research and Service Center, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand for all the analysis.

Finally, I would like to give all my thank to my parents, who have given a grate cheer to me until my success.

Siwat Thungprasert