

**DEVELOPMENT OF CONDUCTIVE AND NON-CORROSIVE  
COATINGS FOR FUEL CELL BIPOLAR PLATES**

**SAKON SANSONGSIRI**

**DOCTOR OF PHILOSOPHY  
IN PHYSICS**

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

Copyright© by Chiang Mai University

All rights reserved

**THE GRADUATE SCHOOL  
CHIANG MAI UNIVERSITY**

**MAY 2009**

**DEVELOPMENT OF CONDUCTIVE AND NON-CORROSIVE  
COATINGS FOR FUEL CELL BIPOLAR PLATES**

**SAKON SANSONGSIRI**

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

**IN PHYSICS**

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่  
Copyright© by Chiang Mai University  
All rights reserved

**THE GRADUATE SCHOOL  
CHIANG MAI UNIVERSITY**

**MAY 2009**

**DEVELOPMENT OF CONDUCTIVE AND NON-CORROSIVE  
COATINGS FOR FUEL CELL BIPOLAR PLATES**

SAKON SANSONGSIRI

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

EXAMINING COMMITTEE

*Vittaya Amornkitbamrung*.....CHAIRPERSON  
Assoc. Prof. Dr. Vittaya Amornkitbamrung

*H. Vilaithong*.....MEMBER  
Prof. Emeritus Dr. Thiraphat Vilaithong

*S. Thongtem*.....MEMBER  
Prof. Dr. Somchai Thongtem

*B. Yotsombat*.....MEMBER  
Assist. Prof. Dr. Banchob Yotsombat

*D. Boonyawan*.....MEMBER  
Assoc. Prof. Dr. Dheerawan Boonyawan

1 May 2009

© Copyright by Chiang Mai University

## ACKNOWLEDGEMENT

I wish to express my sincere gratitude to Assistant Professor Doctor Banchob Yotsombat for his helpful suggestions and support throughout this research and also to the thesis committee, Professor Doctor Somchai Thongtem, Associate Professor Doctor Dheerawan Boonyawan for their valuable comments and also useful suggestions. I am truly grateful to Professor Emeritus Doctor Thiraphat Vilaithong for his suggestions on my task about fuel cell test and metallic bipolar plate development. I also thank him for the opportunity he gave me to present my work at Copenhagen, Denmark.

A special thank go to Doctor Andre´ Anders for his helpfulness when I was in Lawrence Berkeley National Laboratory (LBNL), California, USA. He guided me about my experiments and reviewed all of the manuscripts. I also thank Joel Teague, Joe Walling, Michael Dickinson, and Tom McVeigh for technical support when I was at LBNL. Some part of my work was support by the U.S. Department of Energy, and by Nanochip Inc., Fremont, California, I would like to thank them. My sincere thanks to Doctor Ramon Escobar Galindo at Surface Physics and Engineering Department, Instituto de Ciencia de Materiales de Madrid, Cantoblanco, Madrid, Spain for atomic depth profile measurement by GDOES.

I am truly thankful to Associate Professor Doctor Vittaya Amornkitbamrung (Khon Kean University) for provided his valuable time in reading and participating as examination chairperson.

I would like to thank Chiang Mai University for financial support under the Thai Commission on Higher Education Staff Development project. My acknowledgement also to the office staff and technicians at the Fast Neutron Research Facility (FNRF), Chiang Mai University, who help my work proceed smoothly

throughout this project. My further thank for Thai National Metal and Materials Technology Center (MTEC) for the corrosion test. My acknowledgement also goes to university's friends and senior doctor candidate, especially, Doctor Nitisak Pasaja, for his valuable suggestions and helping.

Finally, I would like to thank my parents for giving me the opportunity to study, thank for my brothers and sisters, who encouraged me along a long period of my study.

Sakon Sansongsiri



ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่  
Copyright© by Chiang Mai University  
All rights reserved