

## ACKNOWLEDGEMENT

This thesis would not have been possible without the assistance and support. Along the way, I met many wonderful people who never hesitated to support me with their hearts and souls.

First and foremost, I would like to express my sincere gratitude to my advisor, Asst. Prof. Dr. Nawarat Nantapong for the kindness, assistance, advice, and consultation throughout this thesis. My thesis advisor patiently communicated knowledge, concepts, and recommendations while also thoroughly correcting the shortcomings until this thesis was accomplished.

I would like to express my deepest gratitude to Dr. Wanwisa Limphirat, Assoc. Prof. Dr. Nuannoi Chudapongse, Asst. Prof. Dr. Oratai Weeranantapan, and Asst. Prof. Dr. Piyada Ngernsounghern, who devoted valuable time to the thesis examination committee. Thank you for your encouragement, sharing ideas, suggestions, and constructive suggestions for improving the thesis.

I appreciate special thanks to the external research fund granter (OROG) for the partial financial support. I would like to offer my sincere thanks to many staffs at the Suranaree University of Technology and the Synchrotron Light Research Institute for their support in the development of this report. I would like to show my thankfulness to all of the lab members for their support and assistance throughout this research.

Finally, I would like to express my deepest gratitude to my parents, relatives, and my friends for always giving me the best support and encouragement in every aspect.

Supavadee Kerdtoob