

ACKNOWLEDGEMENT

First and foremost, I would like to express my deepest gratitude to Asst. Prof. Dr. Sukasem Watcharamaisakul, who provided research guidance, encouragement, and support throughout the research course. Their expertise and valuable feedback have greatly contributed to the quality and completion of this thesis. I am also sincerely thankful to the members of my thesis committee, Assoc. Prof Dr. Jiratchaya Ayawanna, Asst. Prof. Dr. Siriwan Chokkha, and Asst. Prof. Dr. Onlamee Kamon-in, for their recommendations, comments, suggestions, and academic support. My appreciation also extends to my colleagues and friends in the Materials Engineering regarding their collaboration, assistance, and companionship made this academic journey productive and motivated. I am especially grateful to my family for their endless love, patience, and moral support. Their encouragement has been my greatest motivation throughout this academic journey.

Finally, I would like to acknowledge Suranaree University of Technology for providing scholarship support and the Synchrotron Light Research Institute for supporting the research fund and providing an oxygen concentrator for the experiment, particularly from Dr. Pattanaphong Janphuang. Without the support, the successful completion of this thesis would not have been possible.

ABHIRAK SINCHANGREED