## **ACKNOWLEDGEMENTS**

This thesis could not be complited without the help and support of many people, for which I express my sincere gratitude.

I would like to thank Assoc. Prof. Dr. Panomsak Meemon accepted me to study for the Ph.D. and allowed me to carry of research in the field of funding together with some optics funding and supporting from 2016 to 2021.

I want to express my sincere gratitude to my thesis advisor, Assoc. Prof. Dr. Prapan Manyum, provided me the guidance, support, and excellent opportunities to carry out this research activity.

I would like to thank Asst. Prof. Dr. Rattikorn Yimnirand, Chairman of the Thesis

Defense Examination Committee who provides supporting and advice/suggestions on research and science in various fields.

I would like to thank Assoc. Prof. Dr. Jakrapong Kaewkhao, who is also one of the thesis defense committee members for gaving me a scholarship and an opportunity to carry my research in his laboratory the Center of Excellence in Glass Technology and Materials Science (CEGM).

I would like to thank Asst. Prof. Dr. Narit Trimnak member of the thesis defense committee who help me with everything in Nakhon Pathom.

I would like to thank Dr. Dr. Natthapong Wongdamnern who is the thesis defense committee, for assistance and guidance in the research writing.

I would like to give big thank to Dr. Nuantip Wantana, Dr. Wipakorn Rittisut, Ms.Chayani S. Sarumaha, and Dr. R. Rajaramakrishna of the Glass group and Yimnirun group, school of physics, SUT, and Nakhon Pathom Rajabhat University (NPRU), all teachers, my friends, my seniors, my juniors, and all staffs in school of Physics, SUT for their support.

I would like to thank the National Research Council of Thailand (NRCT) for funding. J. Kaewkhao would like to thanks National Research Council of Thailand (NRCT) under Research Grants for Talented Mid-Career Researchers Project. I would like to

express their gratitude to W. Rittisut and N. Wantana for their assistance with the measurements. These studies were also supported by the National Nanotechnology Center's (NANOTEC) Research Network NANOTEC (RNN) program, NSTDA, Suranaree University of Technology's Center for Scientific and Technological Equipment, and Thailand's Synchrotron Light Research Institute (Public Organization).

Finally, I want to express appreciation to my parents, and my sisters for their tremendous lom, support and encouragement.

Atchariyasart Phongsa