IMPROVEMENT OF MECHANICAL PROPERTIES OF CARBON NANOTUBES, SILICON CARBIDE NANOWIRES AND EPOXY RESIN NANOCOMPOSITES

HARUTHAI LONGKULLABUTRA

DOCTOR OF PHILOSOPHY IN MATERIALS SCIENCE

THE GRADUATE SCHOOL
CHIANG MAI UNIVERSITY
MAY 2012

IMPROVEMENT OF MECHANICAL PROPERTIES OF CARBON NANOTUBES, SILICON CARBIDE NANOWIRES AND EPOXY RESIN NANOCOMPOSITES

HARUTHAI LONGKULLABUTRA

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

THE GRADUATE SCHOOL
CHIANG MAI UNIVERSITY

MAY 2012

IMPROVEMENT OF MECHANICAL PROPERTIES OF CARBON NANOTUBES, SILICON CARBIDE NANOWIRES AND EPOXY RESIN NANOCOMPOSITES

HARUTHAI LONGKULLABUTRA

THIS THESIS HAS BEEN APPROVED

TO BE A PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

IN MATERIALS SCIENCE

J. Tonto akoen CHAIRPERSON	From Melmayeny ADVISOR
Assoc. Prof. Dr. Jerapong Tontrakoon	Assist. Prof. Dr. Wim Nhuapeng
Flux Albuapur MEMBER	Wander Hanfare CO-ADVISOR
Assist. Prof. Dr. Wim Nhuapeng	Dr. Wandee Thamjaree
Wande- Florjai MEMBER	Psith Singley CO-ADVISOR
Dr. Wandee Thamjaree	Assoc. Prof. Dr. Pisith Singjai

THESIS ADVISORY COMMITTEE

Helianawon Bardalianam MEMBER

Dr. Atcharawon Gardchareon

EXAMINING COMMITTEE

17 May 2012 © Copyright by Chiang Mai University

ACKNOWLEDGEMENT

It would not have been possible to write this doctoral thesis without the help and support of the kind people around me, to only some of whom it is possible to give particular mention here.

Above all, I would like to thank Assist. Prof. Dr. Wim Nhuapeng, my supervisor for his helpful guidance, persistence and encouragement throughout my graduate studies.

I would like to thank my committee members, Assoc. Prof. Dr. Jerapong Tontrakoon, Assoc. Prof. Dr. Pisith Singjai, Dr. Wandee Thamjaree and Dr. Atcharawon Gardchareon for their helpful encouragement, advices, comments and suggestions in my thesis.

I am also grateful to Assoc. Prof. Dr. Kim Pickering and Mr. Yuanji Zhang, Instrument Technician, Materials and Process Engineering, University of Waikato, New Zealand for their useful suggestions, technical advices and facilities about this work.

I would like to thank all helps and supports from officers and technical staffs of Department of Physics, Faculty of Science, CMU, Mrs. Budsabong Kuntalue for using her talent about TEM analysis on my samples; Mr. Thawatchai Sakorn and Mr. Thirapol Chinda for SEM analysis.

I would like to acknowledge the Thailand Research Fund (TRF) and the Royal Golden Jubilee Ph.D. Program that provided the necessary financial support for this research.

Furthermore, thanks also are given to my best friends, Ms Surangkana Wannapop, Ms. Orapim Namsar, Ms. Tharathip Sreesattabud, Ms. Jirapa Tangsritrakul, and Mrs. Jolanda Smith who have played, helped, cheered and encouraged me to get to this point.

At this stage, I must accord my heartfelt obligations to my family, my mother, my sisters, my brothers, my cousins, and my husband for their love, warmth and curiosity about my education which was live inspiration for me.