FABRICATION AND MECHANICAL AND ELECTRICAL PROPERTIES OF BISMUTH SODIUM ZIRCONATE-BASED COMPOUNDS

PANUPONG JAIBAN

DOCTOR OF PHILOSOPHY
IN MATERIALS SCIENCE

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่ Copyright[©] by Chiang Mai University All rights reserved

THE GRADUATE SCHOOL
CHIANG MAI UNIVERSITY
FEBRUARY 2014

FABRICATION AND MECHANICAL AND ELECTRICAL PROPERTIES OF BISMUTH SODIUM ZIRCONATE-BASED COMPOUNDS

PANUPONG JAIBAN

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
FEBRUARY 2014

FABRICATION AND MECHANICAL AND ELECTRICAL PROPERTIES OF BISMUTH SODIUM ZIRCONATE-BASED COMPOUNDS

PANUPONG JAIBAN

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

EXAMINING COMMITTEE	THESIS ADVISORY COMMITTEE
9 hi CHAIRPERSON	Ah Waldyan ADVISOR
Dr. Navavan Thongmee	Asst. Prof. Dr. Anucha Watcharapasorn
Anh Wolffar MEMBER	S. Joms/s/somboon CO-ADVISOR
Asst. Prof. Dr. Anucha Watcharapasorn	Assoc. Prof. Dr. Sukanda Jiansirisomboon
J. Siomstalscomboon MEMBER	Manoch Walsonta CO-ADVISOR
Assoc. Prof. Dr. Sukanda Jiansirisomboon	Dr. Manoch Naksata
Manach Naksata MEMBER	
Dr. Manoch Naksata	
Supon Lanto MEMBER	
Assoc. Prof. Dr. Supon Ananta	

13 February 2014 © Copyright by Chiang Mai University

ACKNOWLEDGEMENTS

This thesis has been accomplished during the period of June 2009 to September 2013, in co-operation between Department of Physics and Materials Science, Faculty of Science, Chiang Mai University, Thailand, and Department of Electrical and Computer Engineering, University of Texas at San Antonio, Texas, USA.

I must acknowledge many people who have helped me throughout this work and greatly increased the quality of my education. First of all, I would like to acknowledge my supervisor, Asst. Prof. Dr. Anucha Watcharapasorn for valuable suggestion, good supporting and discussions during the course of the Ph.D. project especially during the writing of this thesis. I would also like to thank my committee members, Assoc. Prof. Dr. Sukanda Jiansirisomboon, Dr. Manoch Naksata, Asst. Prof. Dr. Rattikorn Yimnirun, Assoc. Prof. Dr. Supon Ananta and, especially, the external committee member, Prof. Dr. Amar S Bhalla, for their time and efforts to be members of my Ph.D. examination, and for their helpful and valuable comments of the research in general and of this thesis in particular.

I must give a special thank to Prof. Dr. Amar S. Bhalla and Prof. Dr. Ruyan Guo for all opportunities, supports, suggestions and instructions about this work while I was in the Department of Electrical and Computer Engineering, University of Texas at San Antonio (UTSA), USA. I would like to thank Alexandre Josè Gualdi, Yang Li and Jun Li at UTSA for their assistance, helpful suggestion and important knowledge about this work, especially, thermal expansion and dielectric measurements.

I would also like to thank my former Ph.D. colleagues and friends at CMU, Dr. Navavan Thongmee, Miss Pharatree Jaita, Miss Tharathip Sreesattabud, Miss Ampika Rachakom, Miss Pasinee Siriprapa, Miss Orapim Namsa, Miss Napatporn Petnoi, Mr. Methee Promsawat, Miss Preeyakarn Eaksuwanchai, Mr. Poom Prayoonphokkharat, Miss Suwapitcha Buntham and the other members of Electro-Ceramic Research Laboratory, Department of Physics and Materials Science, Faculty of Science, Chiang Mai University who have played, helped, cheered and encouraged me to get to this point. The experiences I have shared with them have helped shape who I am today.

I am very grateful to the Royal Golden Jubilee Ph.D. Program, Thailand Research Fund (TRF) and the Graduate School, Chiang Mai University for their contribution in funding my research.

Most of all I would like to thank people who take care of me, especially my parents and my older sisters, Mr. Insu Jaiban, Mrs. Janpang Jaiban and Mrs. Ratchanee Jaiban for always believing in me and encouraging me to achieve my goals. I would never finish this study without their encouragement and full support. I am truly thankful.

Panupong Jaiban