

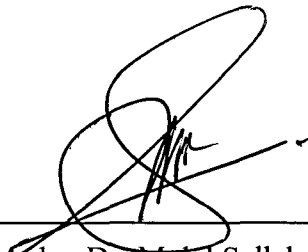
**ULTRASONIC VELOCITY STUDIES ON ELASTIC PROPERTIES
AND ELECTRON-PHONON COUPLING IN $\text{EuBa}_2\text{Cu}_{13}\text{O}_{7-\delta}$
SUPERCONDUCTORS**

NURUL NADIA BINTI MUHAMAD

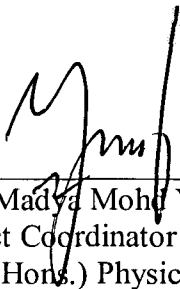
**Final Year Project Report Submitted in
Partial Fulfillment of the Requirements for the
Degree of Bachelor of Sciences (Hons.) Physics
in the Faculty of Applied Sciences
Universiti Teknologi MARA**

MAY 2010

This Final Year Project Report entitled “**Ultrasonic Velocity Studies on Elastic Properties and Electron-Phonon Coupling in $\text{EuBa}_2\text{Cu}_3\text{O}_{7-\delta}$ Superconductors**” was submitted by Nurul Nadia Muhamad, in partial fulfilment of the requirements for the Degree of Bachelor of Science (Hons.) Physics, in the Faculty of Applied Sciences, and was approved by



Prof. Madya Dr. Mohd Salleh Mohd Deni
Supervisor
B. Sc. (Hons.) Physics
Faculty of Applied Sciences
Universiti Teknologi MARA
40450 Shah Alam
Selangor



Prof. Madya Mohd Yusoff Theeran
Project Coordinator
B.Sc.(Hons.) Physics
Faculty of Applied Sciences
Universiti Teknologi MARA
40450 Shah Alam
Selangor

Dr. Ab Malik Marwan Ali
Head of Programme
B.Sc.(Hons.) Physics
Faculty of Applied Sciences
Universiti Teknologi MARA
40450 Shah Alam
Selangor

Date: 12 MAY 2010

ACKNOWLEDGEMENTS

First of all, thanks to Allah S.W.T, the Almighty because of His blessings this thesis was completed on time. My heartfelt thanks goes to my supervisor, Prof. Madya Dr. Mohd Salleh bin Mohd Deni because of his valuable comments and suggestions and precious advices, ideas and support during the process of preparing this thesis and to Miss Shabani bt Ismail for her consistence effort and guidance throughout my project. Special dedications to my beloved parents, Mohamad Nor bin Ali (my uncle) and Zainoon bt Ali, which one always motivating me and support me, emotionally and financially. I would like to express my special thanks to my colleagues for their great support and encouragement throughout the completion of this thesis.

Nurul Nadia Muhamad

ABSTRACT

Longitudinal and shear ultrasonic velocities in Al substituted $\text{EuBa}_2(\text{Cu}_{1-x}\text{Al}_x)_3\text{O}_{7-\delta}$ ($x = 0, 0$ (quenched), 0.06 and 0.10) superconductors have been measured using the pulsed-echo-overlap (PEO) method at frequency 9MHz in the temperature ranges of 80 K-280 K (longitudinal) and 80 K-220 K (shear). Substitution of Al caused the step-like anomaly strongly suppressed and strongly indicates involvement of Cu-O chains at the Cu-site of RE123. For $x = 0$, a step-like elastic anomaly indicate sudden lattice stiffening was observed at temperature 260 K. The characteristic Debye temperature, θ_D and electron-phonon coupling constant were estimated using the standard BCS theory as well as two-dimensional van Hove scenario. The van Hove electron-phonon coupling constant is in the range of $l_{\text{VH}} = 0.030\text{--}0.050$ and Al substitution also has effect of lowering the calculated electron-phonon coupling constant (λ). These finding shows that, the step-like elastic anomaly occurred when substitution of Al^{3+} into Cu-O chain site and effectively destroys the oxygen ordering.

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	vi
LIST OF FIGURES	vii
LIST OF ABBREVIATIONS	viii
ABSTRACT	x
ABSTRAK	xi
CHAPTER 1 INTRODUCTION	
1.1 Background of study	1
1.2 Problem Statement	6
1.3 Significant of study	7
1.4 Objective of the study	8
1.5 Scope of the study	8
CHAPTER 2 LITERATURE REVIEW	
2.1 Copper Oxide-based High Temperature Superconductors	9
2.2 Substitution of RE123	10
2.3 Ultrasonic Velocity Measurement Studies in Superconductor	12
2.4 Superconducting Phase Transition	13
2.5 Electron-phonon Coupling and van Hove singularity	15
CHAPTER 3 METHODOLOGY	
3.1 Materials	18
3.2 Apparatus	18
3.3 Instruments	18
3.4 Preparation of the sample	19
3.4.1 Sample Preparation	20
3.5 Characterization	20
3.5.1 Electrical Resistance Measurements	21
3.5.2 Ultrasonic Velocity Measurements	21
3.5.3 X-ray Diffraction Measurements	23
3.5.4 Scanning Electron Microscopy Measurements	23