

**THE OPTICAL PROPERTIES OF MANGANESE DOPED TIN
OXIDE SYNTHESIZED BY MECHANOCHEMICAL PROCESSING**

FATHIAH BINTI MOD ARIFIN

**Final Year Project Report Submitted in
Partial Fulfilment of The Requirement for the
Degree of Bachelor Science (Hons.) Industrial Physics
in the Faculty of Applied Sciences
Universiti Teknologi Mara**

MAY 2011

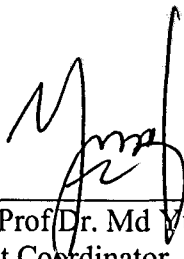
This Final Year Project Report entitled “**The Optical Properties of Manganese Doped Tin Oxide Synthesized by Mechanochemical Processing**” was submitted by Fathiah Binti Mod Arifin, in partial fulfilment of the requirements for the Degree of Bachelor of Science (Hons.) Industrial Physics, in the Faculty of Applied Sciences, and was approved by



En. Azlan Zakaria
Supervisor
B. Sc. (Hons.) Industrial Physics
Faculty of Applied Sciences
Universiti Teknologi MARA
40450 Shah Alam
Selangor



Dr. Mahesh Kumar Talari
Co-Supervisor
B. Sc. (Hons.) Material Technology
Faculty of Applied Sciences
Universiti Teknologi MARA
40450 Shah Alam
Selangor



Asoc. Prof. Dr. Md Yusof Theeran
Project Coordinator
B. Sc. (Hons.) Physics
Faculty of Applied Sciences
Universiti Teknologi MARA
40450 Shah Alam
Selangor

Tn. Hj. Isa Bin Mohd Yusof
Head of Programme
B. Sc. (Hons.) Industrial Physics
Faculty of Applied Sciences
Universiti Teknologi MARA
40450 Shah Alam
Selangor

12 MAY 2011

Date : _____

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENT	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	vi
LIST OF FIGURES	vii
LIST OF ABBREVIATIONS	xii
ABSTRACT	xiii
ABSTRAK	xiv
CHAPTER 1 INTRODUCTION	
1.1 Background and Problem Statement	1
1.2 Significance of study	17
1.3 Objectives of study	17
1.4 Scope of work	18
CHAPTER 2 LITERATURE REVIEW	
2.1 The surface and material science of tin oxide	19
2.2 Comparison stannic (SnO ₂) and stannous oxide (SnO)	20
2.3 Electronic structure of tin oxide	21
2.4 Additives in SnO ₂	22
2.5 Lattice dopants in tin oxide	23
2.5.1 Antimony doped tin dioxide	23
2.5.2 Cobalts doped tin dioxide	25
2.6 Preparation and structure of silicon doped tin oxide composites using an advanced ultrasonic spray method	25
2.7 Preparation of nanosized tin oxide (SnO ₂) powder by homogeneous precipitation	26
2.8 Synthesis of tin oxide nanoparticles by mechanochemical reaction	28
2.9 Mechanochemical processing	29
2.10 High energy ball mill	30
2.11 Structural changes in iron powder during ball milling	30
2.12 Study of the electronic and optical bonding properties of doped SnO ₂	31
2.13 Synthesis and characterization of antimony-doped tin oxide (ATO) nanoparticles by a new hydrothermal method	33
2.14 Structure and magnetic properties in Mn doped SnO ₂ nanoparticles synthesized by chemical co-precipitation method	34
2.15 Effect of the temperatures on structural and optical properties of tin oxide (SnO _x) powder	37
2.16 Optical properties SnO _x	38
2.17 Surface and catalytic properties of doped tin oxide nanoparticles	40

ABSTRACT

THE OPTICAL PROPERTIES OF MANGANESE DOPED TIN OXIDE SYNTHESIZED BY MECHANOCHEMICAL PROCESSING

Pure and transition metal ion (Mn) doped SnO₂ nanoparticles were synthesized using a simple mechanochemical method. Transition metal ions (Mn) concentration of 0.00, 0.02, 0.04, 0.06, 0.08, 0.10 were doped in order to study the influence optical properties. The optical properties of the samples were analyzed using X-ray diffraction (XRD), ultraviolet visible spectroscopy (UV-VIS), and photoluminescence (PL) techniques. The SnO₂ crystallites were found to exhibit tetragonal rutile structure with lattice parameters, revealing that the metal ions get substituted in the SnO₂ lattice. It is observed that the peak position (1 1 0) get shifted to higher angles by increasing the dopant concentration. Hence the lattice parameters (a and c) and the cell volume get decreased due to the ionic radius of Mn is lower than the ionic radius of Sn. A significant blue shift in the UV absorbing band edge was observed with the increase in the amount of the Mn and Co contents. The photoluminescence spectra are measured at room temperature as a function of different Mn²⁺ concentration, respectively. The luminescence processes are associated with oxygen vacancies in the host and related with the recombination of electrons in singly occupied oxygen vacancies with photoexcited holes in the valence band.

CHAPTER 1

INTRODUCTION

1.1 Background and Problem Statement

Nanomaterials is a field that takes a materials science-based approach to nanotechnology. It studies materials with morphological features on the nanoscale, and especially those that have special properties stemming from their nanoscale dimensions. Nanoscale is usually defined as smaller than a one tenth of a micrometer in at least one dimension, though this term is sometimes also used for materials smaller than one micrometer. When nanometer size range is reached, it will alter the mechanical properties, optical properties and will make new quantum mechanical effect. For example, the quantum size effect where the electronic properties of solids are altered with great reductions in particle size. However, nanometer sized cannot see by human being due to its smallest size. Its must used certain equipment to obtain nanomaterial structure. A certain number of physical properties also alter with the change from macroscopic systems.