Chapter One

Introduction

Cadmium telluride (CdTe) is a II-VI compound that has found wide applications in devices such as gamma-ray detectors, infra-red detectors[1], p-n junction and heterojunctions[2,3] and solar cells[4,5]. With a band gap of approximately 1.5 eV, which is near the maximum theoretical efficiency for solar cells and the feasibility of low cost production, thin films of CdTe have received considerable attention in recent years. However the characteristics of these films are highly dependent on the deposition technique. The objective of this work is to investigate the structure, optical and electro-optical properties of electron beam (e-beam) sputtered CdTe thin films.

In Chapter Two the relevant theoretical concepts related to the present study are presented. This includes the optical properties of thin films, the mechanism of electrical conduction in amorphous films and photoconductivity and its relation to trapping and recombination centers in the band gap. In addition optical absorption in quantum structures such as nanoclusters in thin films, colloids and semiconductor doped glasses are also briefly reviewed.

Chapter Three focuses on the deposition and the structural characterization of the films through XRD, SEM and EDAX. Determination of crystal structure and orientation, morphology and stoichiometry of the films were made from these experiments. In addition the variation of parameters such as grain size and stress in the films with the concentration of excess Te in the films were also investigated.

Optical studies are discussed in Chapter Four which contains descriptions of the instrumentation used to perform transmission spectroscopy and thickness measurements. A study on the dispersion of the refractive index was also made. An attempt is made to demonstrate the presence of quantum size effects by nanoclusters in the films through differential absorption analysis; in particular a blue shift in optical energy gap is observed.

Chapter Five deals with the temperature dependence of the dark conductivity and photoconductivity in the films. Emphasis is given on the calculation of the concentration of recombination centers from the photogenerated electrons using Shockley-Read's[6] model of recombination statistics with a continuous distribution of states in the forbidden gap.

The significant findings of this thesis are presented in Chapter Six which also includes suggestions for further work.

Reference

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