"OPTICAL AND ELECTRICAL CHARACTERISATION OF CRYSTALLINE AND AMORPHOUS SEMICONDUCTORS"

BY

S.Sunita

A dissertation submitted to the Institute of Post graduate studies and Research, University Malaya In partial fulfillment of the requirement for the degree of Master of Technology (Material Science).

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Abstract

The aim of this project is to study optical and electrical properties of two different structures, namely crystalline and amorphous semiconductors. The samples studied are crystal silicon, crystal germanium and hydrogenated amorphous silicon. X-ray diffraction technique was used to confirm the crystallinity and amorphous natures of the samples. Fourier-Transform and infrared measurements were carried out on crystalline semiconductors to determine mainly the purity of the sample where as in the case of amorphous semiconductors it was used as a tool to determine the bonding configurations in which the hydrogen atom was incorporated into the amorphous silicon film. Electrical measurements on crystal germanium were done using the Four Point Probe instrument. The conductivity and energy gap of the material was determined. The conductivity of the crystal silicon was too low to be determined by the Four-Probe instrument and as such transverse aluminum electrodes were deposited on the sample and DC conductivity measurements were carried out using Keithley 236 Source Measurement Unit. From the electrical measurements the conductivity and the activation energy of the sample was determined. The optical transmission spectroscopic measurement was also carried out on crystal silicon to determine the absorption coefficient and the optical energy gap. In the case of hydrogenated amorphous silicon, the effects of annealing on the electrical and optical properties of the sample were studied. The film was annealed at temperatures of 100°C, 200°C, 300°C, 400°C and 500°C. DC-conductivity measurements on the film were carried out using lateral aluminum electrodes, at measurement temperatures ranging from liquid nitrogen temperature to room temperature. The conductivity of the film, the extended state activation energy and the density of states at the Fermi level were computed from the electrical measurements. The optical properties of the a-Si:H film was studied by optical transmission spectroscopic technique. From the optical measurements, the refractive index, the thickness of the film, the optical absorption coefficient, and the optical energy gap were calculated. Finally, the role of annealing temperature and the hydrogen content in hydrogenated amorphous silicon were analyzed.

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