ABSTRACT

Polycrystalline CdTe thin films have been deposited via electron-beam evaporation technique onto glass substrates at a temperature of 60 °C under a vacuum pressure of ~ 1 x 10^{-5} torr. Physical as well as electronic properties of the deposited thin films were studied.

Structural investigations revealed the presence of zinc blende structure growing along a preferential orientation of [111] plane. The thin films were formed by agglomeration of small nanocrystallites which varied in sizes from 30 - 110 nm. These crystallites were found to be physically connected as can be seen from the coherence and adhesion of the thin film to the substrate. CdTe thin films prepared resulted in both compressive as well as tensile stress with the former dominating. Elemental analysis by EDX showed the presence of excess tellurium in the prepared samples. This behavior was attributed to the low condensation temperature of Te_2 compared to Cd. The excess Te was suggested to have been incorporated in the formation of grain boundaries and as a thin oxide layer.

The transmittance have been measured at normal incidence and the complex refractive index has been determined in the spectral region of 0.2 - 3.2 μm. Both the optical constants, n and k, showed a dispersion along the spectral region which was found to be thickness dependent. Fundamental absorption edge was evaluated from the first derivative of optical density and was found to be around 1.5 eV. However, a blue shift was oberved in the absorption edge and this was attributed to the quantum-size effect of the nanocrystallites and the presence of strain in the thin films. The contribution of these two effects were found to be smaller (~ 60 %) than the experimental shift observed. The remaining was thought to be due to the presence of amorphous phase and the presence of free Te in the sample.

Al/CdTe junctions prepared showed high dark resistivity (10^6 - 10^7 ohm-cm), which was found to vary with film thickness. A sharp fall followed by a gradual decrease in resistivity was found as the film thickness increases. The behavior was attributed to the crystallite effect as well as the preferential orientation of growth in e-beam evaporated CdTe thin films.