Growth and Optical Characterization of the Yb-In-Se Thin Films

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Abstract

In this study, the growth and the optical investigations of the Yb-In-Se system are studied by means of scanning electron microscopy (SEM), energy dispersion X-ray analysis (EDXA) and ultraviolet -visible light spectrophotometery. The 300 nm thick Yb-In-Se thin films were prepared by the co-evaporation of the ytterbium metal pieces and the α-In_2Se_3 crystal lumps under a vacuum pressure of 10^{-5} mbar. They were observed to exhibit nanocrystalline nature. The average grain size for this nano-crystals is found to be 27 nm. In addition, the optical transmittance and reflectance measurements have shown that the films exhibit a direct forbidden transition type of energy band gap of 1.07 eV. The optical transitions are associated with interband tail states of 0.25 eV width. Moreover, the dielectric spectra for the Yb-In-Se films which were analyzed in the frequency range of 270-1000 THz, exhibited a maxima at 523 THz. The optical conductivity modeling for these films which was carried out in accordance with the Lorentz model allowed determining the free carrier scattering time and the effective mass, the carrier density, the drift mobility and the reduced resonant frequency as 0.15 (*fs*) and 0.125 m_o, 3.2×10^{19} (cm^{-3}), 2.11 cm^2/Vs and 3.4 x 10^{16} cm^{-1} for the Yb-In-Se films, respectively.

Keywords: Optical materials; Coating; Optical dispersion spectroscopy; Dielectric properties;