Compositional Dependence of the Optical Properties of Amorphous $In_x(Ge_{40}S_{60})_{100-x}$ Thin Films

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Chalcogenide glasses are one of the most widely known families of amorphous materials and have been studied for several decades, because of their interesting fundamental properties and wide range of applications. These glasses have attracted considerable attention due to their infrared transparency, low phonon energy and high refractive indices. They have been explored as promising candidates for optical memories, gratings, switching devices. They are used for optoelectronics as infrared elements and devices for acousto-optic devices, holography, xerography and information storage media

Ge–S amorphous system are very good glass-former. The addition of dopants such as Indium (In) controls its electrical and optical properties. Moreover, the Ge–S–In system is of special interest, and it forms glasses over a wide composition range. It occurs up to 15 at.% In and 60–90 at.% Se and the rest is Ge. Various studies have reported on the structural, electrical and optical properties of Ge–S–In glasses. They are characterized by high refractive index, low optical losses and good infrared transparency.

Amorphous $In_x(Ge_{40}S_{60})_{100-x}$ thin films with different compositions (x = 3, 5 and 7 at.%) were deposited onto glass substrates by thermal evaporation. Bulk chalcogenide glasses of the appropriate composition were synthesized by the usual melt quenching technique.

The effect of Indium content on the optical properties of $In_x(Ge_{40}S_{60})_{100-x}$ films was analyzed in the wavelength range 400–2500 nm. The refractive index was found to decrease with the increase of the In content. The behavior of the refractive index with the wavelength was explained using the model of single oscillator proposed by Wemple and Di Domenico. Band gap energy and cohesive energy increase with increasing In concentration.