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Investigation of Thickness Dependent Optical Properties of $Bi_2Sb_{(3-x)}:Te_x$ (where x = 0.1, 0.2, 0.3) Thin Films

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Abstract : Group V-VI compounds have a narrow bandgap, which makes them useful in many electronic devices. In bulk form, BiSbTe alloys are semi-metals or semi-conductors. They are used in thermoelectric and thermomagnetic devices, fabrication of ionizing, radiation detectors, LEDs, solid-state electrodes, photosensitive heterostructures, solar cells, ionic batteries, etc. Thin films of $Bi_2Sb_{(3-x)}$:Tex (where x = 0.1, 0.2, 0.3) of various thicknesses were grown by the thermal evaporation technique on a glass substrate at room temperature under a pressure of 10^{-4} mbar for different time periods such as 10s, 15s, and 20s. The thickness of these thin films was also obtained by using the swaneopeol envelop method and compared those values with instrumental values. The optical absorption (%) data of thin films was measured in the wave number range of 650 cm^{-1} to 4000 cm^{-1}. The band gap has been evaluated from these optical absorption data, and the results indicate that absorption occurred by a direct interband transition. It was discovered that when thickness decreased, the band gap increased; this dependency was inversely related to the square of thickness, which is explained by the quantum size effect. Using the values of bandgap, found the values of optical electronegativity ($\Delta\chi$) and optical refractive index (η) using various relations.

Keywords : thin films, band gap, film thickness, optical study, size effect
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