Dielectric Functions of MBE-grown $Bi_2(Te_{1-x}Se_x)_3$ Thin Films

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Using spectroscopic ellipsometry, the dielectric functions of a series of topological insulators, including Bi_2Te_3, Bi_2Se_3 and their ternary alloys, were determined. The topological insulator-thin films were grown on GaAs substrates using a dual-chamber Riber 32 solid-source MBE system. The ellipsometry measurements were obtained using an IR-spectroscopic ellipsometer, spanning a spectral range between 2000 nm to 35,000 nm. A standard inversion technique was used to model the ellipsometry spectra, which produced the dielectric functions of each of the topological insulator-films. These dielectric functions were analyzed further to obtain characteristics such as their bad gap and carrier concentration. Specifically, Kramers-Kronig-consistent oscillators were used to represent the Drude contribution as well as the energy gap. We found that the band gap blue shifts as the concentration of *Se* increases in the ternary compound. More importantly, best fits for experimental spectra were obtained when an anisotropy was introduced in the dielectric functions of the topological insulators. Furthermore, the model allowed us to calculate the anisotropy of the effective mass, suggesting that there is roughly a factor of four difference between the *xy* and *z*-axis effective masses.

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