Reversible phase change in $\text{Bi}_{x}\text{Se}_{100-x}$ chalcogenide thin films for using as optical recording medium

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Abstract:

The microstructure of electron beam deposited $\text{Bi}_3\text{Se}_{100}$ thin films (where $x$ varies from 0 to 16 at.%) was investigated. The morphology of crystallization for in situ thermally annealed and electron beam heated $\text{Bi}_{16}\text{Se}_{84}$ films was investigated using transmission electron microscopy. Selected area electron diffraction was used to characterize different phases observed during the crystallization process where the crystalline $\text{Bi}_2\text{Se}_3$ phase was separated. Optical absorption measurements were carried out on as-deposited $\text{Bi}_{x}\text{Se}_{100-x}$ films of different compositions. It was found that the mechanism of the optical absorption follows the rule of non-direct transition. The optical energy gap decreases with increasing Bi content. The effect of thermal annealing on the optical properties of $\text{Bi}_{16}\text{Se}_{84}$ films was investigated. The study indicated that $\text{Bi}_{16}\text{Se}_{84}$ films have low threshold energy for amorphization, high optical absorption coefficient and optimum contrast between the amorphous and the crystalline states. The decrease in the optical gap is discussed on the basis of amorphous-crystalline transformations.

Keywords:

Electron beam deposition ; Semiconductor thin films ; Chalcogenide glasses ; Bismuth selenides ; Amorphous state structure ; Crystal structure ; Phase transformations ; Crystalline phase ; Optical properties ; Absorption coefficients ; Reflectance ; Transmittance ; Temperature dependence ; TEM ; Electron diffraction ; Metals Compounds ;

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