Effective penetration depth of optical radiation in nanoscaled modified $Ge_2Sb_2Te_5$<Ag> films

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Thin films of Ge-Sb-Te (GST) chalcogenide semiconductor materials and, in particular, $Ge_2Sb_2Te_5$ composition, are used for creation of optical information carrier on the basis of a "glass-crystal" reversed phase transition. To improve information recording parameters, GST compositions are modified with an admixture of metal. In this case, the impurity must be isovalent and isomorphic with one of the components of the matrix. For the $Ge_2Sb_2Te_5$ composition, one of these impurities is silver.

The report presents the results of study of the optical properties of nanoscale amorphous and crystalline $Ge_2Sb_2Te_5$ films modified with Ag, and spectral dependence of the effective depth of penetration of optical radiation into these materials $d_{eff}(\lambda)$ are also presented.

Amorphous $Ge_2Sb_2Te_5$ films modified with silver (a-$Ge_2Sb_2Te_5$<Ag>) were obtained by ion-plasma RF (13.56 MHz) magnetron sputtering of a combined target from a polycrystalline of $Ge_2Sb_2Te_5$ and Ag. The film thickness l was ~ 100 nm, and the silver impurity concentration in the films was reached 5 at.%. Crystallization of the amorphous films was carried out by thermal heating. The phase state of the film structure was monitored using Raman spectroscopy.

The optical properties of the films (transmission spectra $T(\lambda)$ and reflection $R(\lambda)$ of light) were recorded on a Shimadzu UV2000 spectrophotometer in the range from 300 to 1100 nm. The spectral characteristics of light absorption $\alpha(\lambda)$ of the films were calculated from the expression $\alpha(\lambda) = -1/l \cdot \{\ln[T(\lambda)/(1-R(\lambda)^2]\}$. The effective penetration depth $d_{eff}(\lambda)$ of the optical radiation for the films was determined from the relation $d_{eff}(\lambda) = 1/\alpha(\lambda)$. Analysis of the spectral dependences $d_{eff}(\lambda)$ for amorphous and crystalline $Ge_2Sb_2Te_5$<Ag>films showed that the effective depth of light penetration decreases significantly with increasing impurity concentration. In c-$Ge_2Sb_2Te_5$<Ag>crystalline films, it is much smaller than in amorphous a-$Ge_2Sb_2Te_5$<Ag> films.

The obtained results are important for creating optical information carriers based on nanoscaled $Ge_2Sb_2Te_5$<Ag>films using radiation from lasers with different wavelength.

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