

Optical properties of $\text{Ge}_x\text{As}_y\text{S}_{1-x-y}$ films under electron irradiation and thermal annealing

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Study results of GeS_2 based films under electron irradiation of different intensities and thermal annealing have been presented. Basing on consideration of Raman spectra, structure changes in the films have been concluded to be probable.

Представлены результаты исследований пленок на основе GeS_2 при электронном облучении различных интенсивностей и термоотжиге. Основываясь на данных анализа спектров комбинационного рассеяния, сделан вывод о вероятных структурных изменениях в пленках.

Chalkogenide glasses (CG) based films are used as optical coatings in optical instrument building branch [1]. To form interference structures, the vacuum thermal evaporation technique is still used most often [2]. The short-range order structure of the CG films so produced differs considerably from that of the initial bulk glasses due to non-equilibrium deposition conditions [3].

The stability of condensate properties under external influences is among the conditions of importance when selecting materials for interference structures and waveguide ones [4]. As the films are subjected to various radiation kinds, energy absorption occurs, the amount of the energy absorbed being sufficient to irreversible structure changes followed by destruction [4, 5]. It has been found [5] that doping of $a\text{-GeS}_2$ results in improved dynamic and irradiation resistance of the bulk glasses. Thus, it is of interest to study the stability against electron irradiation and thermal annealing for the GeS_2 films doped with As_2S_3 and As as compared to that of undoped ones.

To study the thermal structure effects, films of $(\text{As}_2\text{S}_3)_{0.2}(\text{GeS}_2)_{0.8}$, GeS_2 , and $\text{As}_{0.1}(\text{GeS}_2)_{0.9}$ were subjected to thermal an-

nealing. The annealing temperatures were selected taking into account the softening temperature (T_g) of the initial glass. The T_g values are known to be 473 K for As_2S_3 and 746 K for $a\text{-GeS}_2$. The GeS_2 films were annealed at 623 K. The films were annealed in vacuum ($7 \cdot 10^{-5}$ Torr) using a VUP-2K unit. The annealing temperature was controlled using a thermocouple. The annealing duration was either 0.5 or 1.5 h. The irradiation was carried out using a 5 MeV electron beam accelerated in a M-10 microtrone. The integral flow intensity was 10^{14} , 10^{15} , $9.1 \cdot 10^{15}$, and 10^{16} electrons per cm^2 . The heat was removed from the film being irradiated on a substrate using a cassette with air-cooled radiator.

The intrinsic absorption edge of the films was studied using a SF-46 spectrophotometer. The intrinsic absorption edge position was calculated from the transmittance and reflectance values using multiple reflections. The film thickness was determined using the procedure described in [6]. The average coordination number Z in the $\text{Ge}_x\text{As}_y\text{S}_{1-x-y}$ films was calculated using the relationship [7–9]:

$$Z = 4x + 3y + 2(1 - x - y). \quad (1)$$