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Formation and properties of glasses in the system of $\text{BaCl}_2\text{-Bi}_2\text{O}_3\text{-TeO}_2$

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Glass formation in $\text{BaCl}_2\text{-Bi}_2\text{O}_3\text{-TeO}_2$ was investigated by melting of starting mixtures in open silica tubes in flame. Chemically pure (purity 3N+) BaCl_2 , Bi_2O_3 and TeO_2 were used as starting compounds. Large glass forming area is located near TeO_2 -rich corner of the ternary diagram and reaches up to 30 BaCl_2 – 30 $\text{BiO}_{3/2}$ – 40 TeO_2 composition. Bulk samples were obtained by pouring the melt in brass mold; the solidified glasses were annealed at the temperature near their glass transition temperature (T_g) and then slowly cooled down to room temperature. The T_g of these glasses determined by differential scanning calorimetry at heating

rate of 10°C/min are in the range of 330–340°C. The obtained glasses are thermally stable – the crystallization temperatures are around 450°C in the case of BaCl₂-TeO₂ binary glasses and higher than 480-500°C in the case of ternary glasses. The composition of the batch slightly changes during melting; generally the concentration of Bi and Cl decreases. The density of the prepared glasses is between 5.2 and 6.1 g/cm³, the refraction index estimated using optical microscopy is approximately 2.3. The window of optical transparency of investigated glasses is between 350 nm and 6.5 μm and their transmittance reaches up to 70%. Unfortunately the OH⁻ groups are present in the prepared glasses; they are manifested by strong absorption band located at 3 μm in the infrared part of spectra.

Structure of nanosized Ge₂Sb₂Te₅ films with silver impurity

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The paper presents the results of studying the structure of nanosized films Ge₂Sb₂Te₅ with silver impurity (Ge₂Sb₂Te₅<Ag>). The films were obtained by the method of ion-plasma high-frequency magnetron sputtering. Upon receipt of the films, a combined target was used, consisting of the composition Ge₂Sb₂Te₅ of AciAlloys (USA) and Ag. The composition of the films was controlled by energy-dispersion analysis (EDXA) on the SEM Quanta 3D 200i. The film thickness was determined by scanning on SEM cleavage of c-Si / Ge₂Sb₂Te₅ <Ag> film and ranged from ~ 50 to ~ 100 nm. The concentration of silver impurities in the Ge₂Sb₂Te₅ <Ag> films reached 12.3 at.%.

The morphology and structure of the films was studied by using SEM, TEM (JEM 2100 JEOL) and Raman spectroscopy (Solver Spectrum 600/600). From the analysis of the results of EDXA and SEM, it follows that Ge₂Sb₂Te₅ and Ge₂Sb₂Te₅ <Ag> films are solid, homogeneous, and there are no defects of micron size in them. The maximum deviation of the components Ge, Sb, and Te from the formula ratio does not exceed 5 at.%. Based on the data of elemental analysis of Ge₂Sb₂Te₅ <Ag> films, we can conclude that Ag atoms in the matrix of Ge₂Sb₂Te₅ films replace mainly Te atoms.

Using Raman spectroscopy (RS) and transmission electron microscopy (TEM) methods, it has been established that freshly prepared Ge₂Sb₂Te₅ <Ag> films have an amorphous structure for all the silver impurity concentrations studied. It is shown that Ge₂Sb₂Te₅ films are characterized by a cellular structure. In the Ge₂Sb₂Te₅ <Ag> films with increasing concentration of the Ag impurity, the transformation of the cellular structure into the cluster one is observed. When studying the structure of Ge₂Sb₂Te₅ <Ag> films by RS and SEM in a crystalline state, it was found that their structure is granular, polycrystalline and hexagonal. With an increase in Ag concentration in Ge₂Sb₂Te₅ <Ag> films, an increase in the grain size from ~ 2.5 to ~ 10 nm occurs and a single-crystal phase is observed.