Nanoplasmonics and surface enhanced spectroscopy

Structural and optical studies of $(Ag_3AsS_3)_{0.6}(As_2S_3)_{0.4}$ thin film with embedded Au nanoparticles

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Semiconducting Ag-As-S chalcogenide glasses and films are widely used for many current and potential applications, such as solid electrolytes for batteries, electrochemical sensors, photoresists, optical waveguides, optical recording materials, surface patterns and other optical and optoelectronic elements. In the recent years surface plasmon has been used to enhance photostructural changes due to laser light. Such surface plasmon resonance was revealed to influence the photoinduced transformations in chalcogenide As-S(Se) thin films. Therefore, it is now of a certain practical interest to obtain and examine such effects in $Ag_3AsS_3)_{0.6}(As_2S_3)_{0.4}$ thin films.

Synthesis of the initial Ag-As-S glasses and composites was carried out at 700°C temperature during 24 h with following melt homogenization during 72 h. Gold nanoparticles (GNP) were obtained on the glass substrate by annealing of deposited by thermal evaporation thin gold film. $(Ag_3AsS_3)_{0.6}(As_2S_3)_{0.4}$ thin films were deposited by the thermal evaporation at near 1350ºC in vacuum using VU-2M equipment from the bulk materials on Si glass substrates previously covered with GNP film. Average thickness of the sandwich structure with GNP was measured to be 650 nm. Structural investigations were performed using SEM and AFM. Optical transmission measurements were performed using Shimatzu UV-3600 grating monochromator.

AFM measurements have shown the film with GNP to have higher mean roughness comparing to the films without Au. Optical transmission spectra of the as-deposited $(Ag_3AsS_3)_{0.6}(As_2S_3)_{0.4}$ thin film and the sandwich with GNP are studied at room temperature. The most probably a minimum of the spectrum of Au, which corresponds to the plasmon resonance frequency of gold, shifted to the

longer wavelengths in the sandwich structure, thus resulting in the reducing of the transmission peaks.