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The fabrication of relief grating on multilayers of chalcogenide glasses

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The possibility of direct surface structure formation for different materials is matter of current interest. As rule, works mainly belongs to such materials as polymer films where relations of surface relief and vector polarisation hologram recording were examined. In this case, recording light polarisation was ascertained as well mass transport role for the process. At the same time, the possibility of surface relief formation for chalcogenide films that contained As, S and Ge explained by photo-structural transformations is the subject of permanent interest lately

The films were prepared by computer driven deposition in one vacuum cycle. The technology allows depositing thin films with thicknesses from 0.005 up to 3.0μm. Overlapping part of samples contains alternating 200 nanolayers of $Ge_5As_{37}S_{58}$ with thickness of 7nm and Se with thickness of 10nm. Resulting sample was $Ge_5As_{37}S_{58}$ –Se multilayer structure with total thickness 1760 nm with the composition modulation period 17 nm.

Diffraction gratings with 1 μm period were recorded by two laser beams with *s–s* polarization by green laser, 532nm wavelength and power 100mW) with synchronous diffraction efficiency measurement by red laser in first diffraction order. We have shown that diffraction efficiency of recorded grating is much more in $Ge_5As_{37}S_{58}$ –Se multilayers (ten times as much) then in pure $Ge_5As_{37}S_{58}$ due to relief grating formation. In the $Ge_5As_{37}S_{58}$–Se system diffraction efficiency of 18% in absolute value was obtained at 0.65 μm illumination wavelength. The surface relief of the gratings was investigated by atomic force microscopy (AFM). The application of $Ge_5As_{37}S_{58}$ –Se multilayers lead to decrease in the time of holographic recording, i.e. to increase of holographic sensitivity by two times in comparison with As_2S_3-Se multilayers under similar conditions of holographic recording. Due to the changes in transmission, reflection, and in thickness under the influence of laser irradiation, $Ge_5As_{37}S_{58}$ –Se multilayers may be used for effective amplitude-phase optical information recording, for the production of surface-relief optical elements.

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