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Ultrashort laser irradiation is proven as an alternative to lithography for nanostructuring surfaces of various materials via formation of laser-induced periodic surface structures (LIPSS) or ripples [1]. In this work, our efforts were focused on the study of LIPSS formation with the periodicity of the order of laser wavelength on surfaces of $Ge_2Sb_2Te_5$ (GST225) amorphous thin films. GST225 composition is one of the extensively investigated phase change memory (PCM) materials, which is currently used for rewritable data storage applications based on structural phase transitions. In addition, we studied the processes of laser crystallization and laser amorphization of GST225 thin films under ultrashort pulsed irradiation.

The GST225 amorphous thin films have been prepared by *dc* magnetron sputtering. We used a Yb:KGW femtosecond laser with wavelengths λ=515 and 1030 nm, pulse duration of 600 fs, and repetition rate of 200 kHz to study surface modification.

It is shown that, with specially selected parameters of the laser irradiation (laser pulse fluence, number of pulses, and light polarization), it is possible to realize LIPSS formation with the periodicity of the order of laser wavelength in the pre-ablation regime. The characteristic feature of the surface nano-structures is the presence after the laser action of the periodic modulation of the refractive index of the ridges and valleys of the gratings due to different phase states whose dielectric constants differ greatly from one another. The formation of LIPSS originates from the interference of the incident light with surface electromagnetic wave excited by irradiation. We used the model of heterogeneous crystallization for objects with different surface curvatures to explain the observed effect of the phase transformation in laser-induced periodic surface structures.

Acknowledgements

This work was supported by RFBR (17-03-00450).

References

[1] R. Buividas, M. Mikutis, S. Juodkazis. Progress in Quantum Electronics 38 (2014) p. 119–156.

Chalcogenide based nano-layered solid electrolytes

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It is well-known that extensive interphase surface promotes ion conductivity. Nano-layered thin films are suitable for investigation that phenomenon.

Films composed of alternating AgI (or Ag_2Se) and glass nanolayers were prepared via laser ablation. For this aim the following glass compositions were used: [0,4AgI·0,3$GeSe_2$·0,3Sb_2Se_3], [0.75(0.5$GeSe_2$·0.25Sb_2Se_3·0.25As_2Se_3)·0.25Ag_2Se], [V_2O_5·GeO_2].

Thickness of two nearby layers is changed from 20 up to 100 nm. Total film thickness is 1 μm. Temperature dependencies of multilayered film specific conductivity were studied using impedance spectroscopy method. To specify phase transitions occurring in the thermal treated film, dependencies of XRD spectra on temperature were studied.

The method of fabrication via laser ablation of stoichiometric and perfectly oriented film of silver selenide is developed. Furthermore, Ag_2Se amorphous stoichiometric thin film stable at room temperature was prepared and investigated. AgI stoichiometric films were obtained by laser ablation also.

"Imprint mechanism" of interlayer influence is discussed in the report. Suppose that glass-forming temperature is higher than the temperature of the AgI (for example) $\alpha \leftrightarrow \beta$ phase transition. α-AgI strongly impacts the glass structure if the temperature of the multilayered film is higher than the T_g and the glass layers are soft. When temperature decreases below the T_g, a glass structure adapted to the α-AgI structure freezes. During further a temperature decrease, when the temperature falls below the temperature of $\alpha \rightarrow \beta$ phase transition, the frozen glass structure preserves the alpha modification of AgI. All of this can be implemented only if the thickness of AgI layer is sufficiently small.

It is observed that nanolayered films after heat treatment usually form a metastable state with high conductivity (about 1 $Ohm^{-1}cm^{-1}$) and low activation energy (about 0.1 eV).

Acknowledgments

The research is supported by RFBR (grant № 17-03-00121). The measurements were performed at the following Research Centers of the SPSU: "X-ray Diffraction Studies", "Nanotechnology Interdisciplinary Center", "Diagnostics of Functional Materials for Medicine, Pharmacology and Nanoelectronics" and "Optical and Laser Materials Research".

Polarization holographic recording of diffractive elements on amorphous chalcogenide nanomultilayers

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In contrast to the conventional holographic process, in which intensity variations in an interference pattern between an object beam and a reference beam are recorded, polarization holography employs beams with two different polarizations for recording information. In this case, the polarization state of the resultant beam is recorded on a suitable medium. In present work we have shown that nanomultilayers structures (NML) based on ChG-Se are sensitive to different states of polarizations of recording beams which gives the possibility to increase the diffraction efficiency of patterned surface relief gratings.

To further improve quality of diffraction structures we apply the direct surface patterning of materials by a laser beam without chemical etching, what attracts high interest due to advantages like high flexibility and precision, moderate cost, and high speed. Absence of selective wet etching is the advantage of such media because used etchants are toxic and during selective etching process it is necessary to control many parameters (temperature, concentration of etchant, etc.). Nowadays direct surface relief writing is a well-developed technique to fabricate 2D or 3D