Table 1. The phase composition of the clays

№	Sample	Phase composition
1	Kaolin	Kaolinite $Al_4(OH)_8\ Si_4O_{10}$
2	White-blue clay	Kaolinite, $Al_4(OH)_8\ Si_4O_{10}$ – 73 % α-quartz.SiO_2 – 27 %
3	Light-blue clay	α-quartz., SiO_2 – 66 % Calcite $CaCO_3$ – 34 % Montmorillonite $Na_{0.3}\ (Al, Mg)_2\ Si_4O_{10}\ (OH)_2 \cdot nH_2O$

As can be seen from Table 2, the clays of the kaolin series have a lower specific surface area than bentonite clay has. Features of the adsorption-desorption nitrogen isotherms are different. The appearance of hysteresis, characteristic for slit-like pores, indicates that adsorption occurs between the lattice spacing of montmorillonite. The addition of highly disperse silica to the system increases the dispersion and affects the course of adsorption-desorption processes.

Table 2. Textural characteristics

№	Sample	S_{BET}, m^2/g	V_p, cm^3/g	R(BJH),nm	
				Ads.	Des.
1	Kaolin	8	0,04	30	29
2	White-blue clay	29	0,15	23	21
3	Light-blue clay	28	0,04	11	8
4	Kaolin/A300	19	0,11	27	25
5	White-blue clay/A300	33	0,15	21	20
6	Light-blue clay/A300	39	0,08	13	11

Surface patterning using As_2S_3: Mn–Se nanomultilayer structures

O. P. Paiuk[2], A. Meshalkin[1], L. Revutska[3], A. Stronski[2], E. Achimova[1], A. Prisacar[1], G. Triduh[1], V. Abashkin[1], P. Oleksenko[2], A. Korchovyi[2]
[1]Institute of Applied Physics, AS Moldova, Chisinau, Moldova
[2]V. Lashkaryov Institute of Semiconductor Physics NAS of Ukraine, Kyiv, Ukraine, *e-mail: stronski@isp.kiev.ua*
[3]National Technical University of Ukraine "Igor Sikorsky KPI", Kyiv, Ukraine

Chalcogenide glasses and films have unique properties: high transparency in the IR region, photoinduced change of properties, quasi-stability, ion-conductivity of doped chalcogenide glasses and films. Nanomultilayer structures on the base of chalcogenide glasses attract much attention due to their property of surface relief formation under light or e-beam exposure [1–3] with promising applications in optical elements fabrication, holography, etc.

The aim of this study is to investigate peculiarities of photo-stimulated processes during surface relief formation in As_2S_3 : Mn–Se nanomultilayer structures. The As_2S_3 : Mn glasses doped by manganese were prepared by melt quenching [4]. The main observed effect under the introduction of manganese into As_2S_3 is the change of relative concentration of the main and non-stoichiometric structural units characteristic for As_2S_3 glasses [4]. Optical properties of As_2S_3 : Mn–Se nanomultilayer structures (NML) and constituent As_2S_3 : Mn and Se layers were obtained from transmission data (450–900nm) using Swanepoel method. Thickness of NML was ~ 1171 ± 12nm. Values of optical band gap E_{gopt} were obtained using Tauc dependence $(\alpha h\nu)^{1/2} = B^{1/2}(h\nu - E_{gopt})$. For NML values of E_{gopt} consisted 1.93 eV and were close to that of Se layers.

Direct surface relief formation of holographic diffraction gratings using As_2S_3 : Mn–Se MNL as recording media and different polarization of recording beams (parallel linear P : P and orthogonal circular L : R) was revealed. Diffraction efficiency (DE) was calculated as ratio of intensity in first order of diffraction to the total light intensity transmitted through the sample. Gratings recording kinetics monitored by diffraction efficiency (DE) dependence on exposure was different for P : P and L : R polarizations. Maximal obtained DE values consisted ~34 % for P : P and ~ 9 % for L : R polarizations. AFM image of recorded grating using P : P polarizations is shown in Fig. 1. Grating period was 1.1 μm. Relief profile was close to sinusoidal one.

Digital holograms were also recorded using As_2S_3 : Mn–Se MNL as recording media. Initial amplitude graphical object (text UA) (Fig. 2, *a*) was used to synthesize digital hologram (Fig. 2, *b*) by Matlab software. Obtained hologram was projected on NML structure using spatial light modulator that led to forming of surface relief pattern on recording media. Reconstructed image in the first order of diffraction from recorded hologram of UA graphical object is shown in Fig. 2, *c*.

The obtained results show that nanomultilayer systems on the base of chalcogenide glasses are perspective recording media for the fabrication by direct recording of different optical elements and also for recording of phase holograms using digital holography methods.

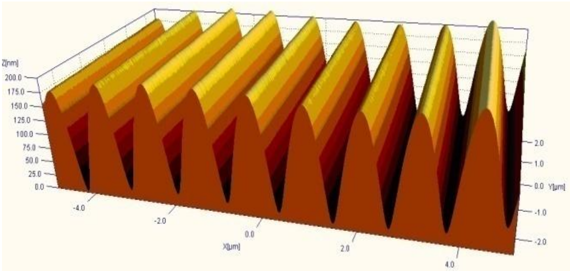
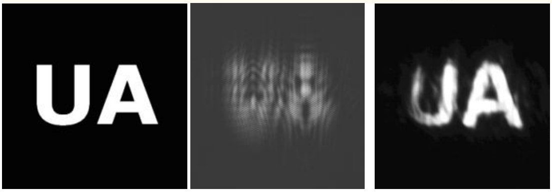


Fig. 1. AFM image of grating recorded using As_2S_3:Mn–Se NML



a *b* *c*

Fig. 2. Initial text graphical object (*a*), synthesized hologram (*b*) and reconstructed amplitude image (*c*)

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Raman spectroscopy studies of As–Se–S chalcogenide glasses

L. Revutska[1], K. Shportko[2], A. Stronski[2],
J. Baran[3], P.Oleksenko[2], E. Venger[2]

[1]National Technical University of Ukraine “Igor Sikorsky KPI”, Kyiv, Ukraine, *e-mail: liubov.revutska@gmail.com*

[2]V. Lashkaryov Institute of Semiconductor Physics NAS of Ukraine, Kyiv, Ukraine

[3]Institute of low temperatures and structure research, PAS, Wroclaw, Poland

Chalcogenide glasses and films attract much attention due to their properties: transparency in the IR region, photoinduced change of properties, quasi-stability, ion-conductivity of doped chalcogenide glasses and films serve as a base of their numerous applications. Chalcogenide glasses (CG) are widely used