Green's Function in conjunction Dyson's equation was defined on it to reduce it to Volterra equation of second type with the kernel $k(z, z') = G(z, z')V(z')$ is solved using series solution technique in conjunction with Born approximation method in order to obtain a model equation of wave propagating through the thin film.

This was used in computing the propagated field,$\psi(z)$ for different input regions of field wavelength such as ultraviolet, visible and infrared region respectively during which the influence of the dielectric constants of the thin film on the propagating field were considered. The results obtained from the computed field were used in turn to compute the band gaps, solid state and optical properties of the thin film such as reflectance, Transmittance and absorbance.

Nano-structure formation in ternary chalcogenide thin films

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Thin films of As-S-Se-Sn and As-Se-Ge chalcogenide semiconductors of different composition have been used for direct e-beam recording of diffraction grating structures by SEM, EBL, and holography techniques. As a result it was established that in these gratings besides modulation of the amplitude phase characteristics the formation of a nano-relief takes place, which correspond to the amplitude and relief-phase changes (Fig.1). The recorded grating structures in studied thin films also were examined using the AFM (Fig.2). The dependence of the diffraction efficiency of gratings with the period of $\Delta=1$ μm and $\Delta=2$ μm versus the radiation dose and composition was investigated.

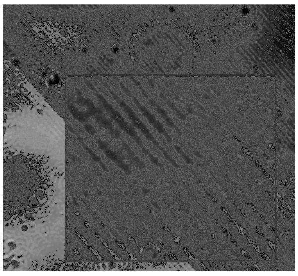

Fig.1 AFM image of the surface relief grating structure

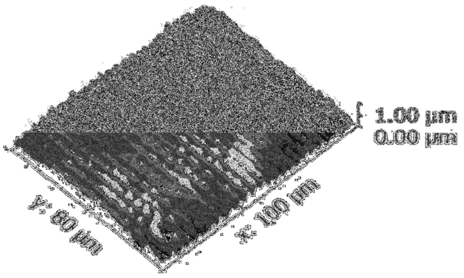

Fig.2 Modulation of the film thickness by EBL

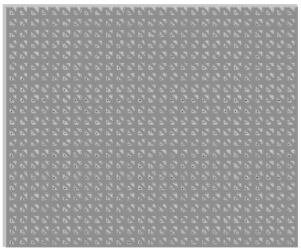

Fig.3 The design of superimposed complex structures

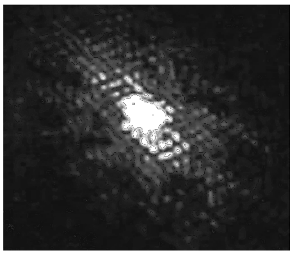

Fig.4 Superimposed complex micro-relief structures

The design of complex optical elements was developed (Fig.3) and superimposed complex relief structures (Fig.4) were realized by EBL using high precision electron beam positioning computer soft. The mechanism of electron-beam recording of diffraction gratings in chalcogenide films mainly is attributed to periodic modulation of their refractive index and transmittance, caused by induced structural transformation.

Acknowledgments

This work was supported by the project CSSDT 15.817.02.03A and CSSDT 16.80012.50.22A. The part of the experiments has been performed in the Center for Surface Science and Nanotechnology, UPB (CSSN).

Surface plasmon resonance using As_2S_3 film for water salinity detection

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Amorphous chalcogenide As_2S_3 films used in surface plasmon resonance structures improves the sensitivity of sensors using such structures by providing them with sharp resonance characteristics: changes at the sixth decimal of the ambient medium refractive index cause important changes of the reflectivity. This high sensitivity is fructified to determine the salinity of the water. The salinity of the water changes the refractive index of the water under test and these changes are put in evidence by the plasmon resonance.

A four layers Kretschmann configuration was taken into consideration, comprising a BK7 prism, a gold thin film, a chalcogenide As_2S_3 film and the ambient medium, which is the sea water. The transfer matrix formalism was used in our study to determine the reflectances characterizing the plasmonic structure.

First a large amount of combinations of thicknesses of gold and As_2S_3 layers over a large wavelength range (using 21 wavelengths corresponding to usual laser sources, mostly laser diodes, emitting in the range 405 – 1625 nm) and for incidence angles ranging between 10° and 80° are calculated in order to determine a plasmonic structure with an optimal sensitivity for the sea water. The two polarization modes (TE and TM) will be taken into consideration, in order to determine the best configuration that allows an optimal sensitivity.

This optimal structure is selected also by choosing a convenient operating wavelength that allows both a good sensitivity and a cheap light source. With these data, the design will be improved by refining the determination of the thicknesses of gold and As_2S_3 layers.

Graphs of the reflectance vs. incidence angle for different refractive index variations of the sea water will show the incidence angle at which the resonance occurs (a parameter useful to the design of the sensor) and the sensitivity of the setup (the sensitivity of the sensor made using this setup).

These simulations are important for the design of a salinity sensor that uses surface plasmon resonance structures with amorphous chalcogenide film. Thus are set the constructive parameters of the structure: the thicknesses of the amorphous chalcogenide film and of the metal