SSDP 4 P SUPERIMPOSED DIFFRACTION GRATINGS FORMED BY E-BEAM RECORDING IN CHALCOGENIDE FILMS

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Amorphous films of arsenic chalcogenide are well known as registration medium for optical and e-beam recording. Structural changes induced by recording irradiation result in high stimulated modulation both of refractive index and chemical etching rate of these films. The amorphous As-S films exhibit wide range of increasing of refractive index with dose of irradiation. Moreover the good recording resolution can be achieved due to structure change mechanism. Therefore the amorphous As-S films are attractive registration materials for recording of superimposed diffraction gratings, that is, the group of diffraction elements situated onto common space region of the medium of registration.

Superimposed diffraction gratings were formed by the alternate e-beam recording, which was carried out in the scanning electron microscope BS 300. Beam current, determining the dose of electron irradiation, was ranged from 0.6 to 4 nA.

Grating structures composed of three (N-3) and four (N=4) crossed diffraction gratings with equal periods (1 μm) were formed. Two (N=2) superimposed equally oriented diffraction gratings with close period values differed in 100 and 50 nm were recorded as well.

The phase grating structures composed of index modulation gratings were formed in the As-S films by direct e-beam recording. The relief grating structures were formed in the As-S films by chemical development in KOH water solution of the previously studied index grating structures. The diffraction efficiency (η_1) was measured in the first diffraction order at normal incidence of He-Ne laser beam (wavelength 0.633 μm). The diffraction efficiencies of superimposed gratings (η_{1N}) were compared with ones of the same single gratings (η_{1S}). The influence of recording current value on diffraction efficiency of gratings was studied.

It was established, that at low values of recording current the independent superimposition (without reciprocal effect) of crossed index gratings can be occurred. Contrary to this, in the case of the relief structures the efficiencies of superimposed gratings were smaller, than ones of the same single gratings even for low recording currents. For structures composed of four identical crossed gratings of 1 μm period the maximum diffraction efficiency of each constituent grating was about 5 % in comparison with one of 33 % for single grating.

For equally oriented superimposed gratings with close values of grating period the effect of efficiency increasing, caused by superimposition, has been revealed both in the case of planar structure and relief structure.

Surface profiles of relief superimposed gratings was studied in scanning electron microscope and in atomic force microscope. Mosaic surface structure of crossed gratings was observed. The beat period of structure formed by equally oriented superimposed gratings was clearly seen.