

Holographic recording and AFM characterization of diffractive optical elements in azopolymer–Au Nanocomposites**V. Botnari^{1*}, E. Achimova¹, V. Abaskin¹, A. Meshalkin¹, V. Cazac¹, C. Loşmanschii¹, D. Spoială²**¹Moldova State University, Institute of Applied Physics, Chişinău, Moldova²Moldova State University, Chişinău, Moldova***Email:** vladislav.botnari@ifa.usm.md

Abstract. Azopolymer nanocomposites doped with gold nanoparticles represent promising photoresponsive materials for the fabrication of diffractive optical elements due to their strong photoinduced surface mass transport. In this work, diffraction gratings and vortex-type diffractive optical elements were recorded in thin films of azopolymer nanocomposites containing Au nanoparticles, followed by morphological characterization using atomic force microscopy (AFM). AFM analysis revealed well-defined surface relief structures with an average fringe period of approximately 7.5 μm . The influence of recording polarization on surface modulation and diffraction efficiency was investigated in detail for the nanocomposite containing 0.8 $\mu\text{g/ml}$ Au nanoparticles, which exhibited the most stable relief formation. For circular polarization (RLCP), a surface modulation depth of 521 nm was obtained for a film thickness of 990 nm ($\sim 52.6\%$ of the film thickness). Under $\pm 45^\circ$ linear polarization, the relief depth reached 706 nm, while for parallel linear polarization (PP) the modulation increased to 945 nm, corresponding to approximately 95% of the film thickness. The diffraction efficiency (DE) strongly depends on the recording polarization, reaching 37.6% for RLCP, 38.8% for $\pm 45^\circ$ polarization, and approximately 20% for PP polarization. Vortex diffractive optical elements were also successfully recorded in the nanocomposite films, with a diffraction efficiency of 23% for the 0.8 $\mu\text{g/ml}$ sample, while the highest vortex efficiency of 35.2% was obtained for the sample containing 1.2 $\mu\text{g/ml}$ Au nanoparticles. These results demonstrate the strong influence of nanoparticle concentration and recording polarization on the formation efficiency of diffractive optical elements in azopolymer nanocomposites, highlighting their potential for applications in photonic and structured light devices.

Keywords: Azopolymer nanocomposites; gold nanoparticles; diffractive optical elements; vortex beams; diffraction efficiency; atomic force microscopy; holographic recording; nanophotonics.

References

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