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Nondestructive readout of Bessel holograms in external magnetic field

Rafael Drampyan, Paytsar Mantashyan, Lusine Tsarukyan and **Ruben Hovsepyan**
Institute for Physical Research - NAS, Armenia

Statement of the Problem: Photonic lattice structures optically induced by holographic technique are very promising for many applications. Nondiffracting beams are of particular interest for optical induction of high-contrast μm-scale refractive lattice structures in photorefractive and liquid crystals providing unchanged lattice structure over the length of medium compared to diffractive methods which widens the applications field. One of the problems for practical applications is erasure of holograms by homogeneous light during readout process. We report a novel method for non-destructive readout of holograms in photorefractive crystals in an external magnetic field. Experiments were performed for Bessel-like lattices.

Materials & Methodology: CW single mode laser beam at 532 nm and 17 mW power was used for formation of Bessel beam with concentric ring profile having 10 μm periodicity by an axicon. The Bessel-like lattices were recorded in Fe doped lithium niobate crystal with optical C-axis along crystal surface. The readout of recorded lattices was performed by diffraction of Gaussian beam at the same wavelength on the lattices, which provides quantitative measurements of lattice diffraction efficiency. Directions of magnetic field, C-axis of the crystal and readout beam were mutually perpendicular. The stability of recorded lattices against erasure during readout was studied by measuring the time evolution of hologram diffraction efficiency for readout beam power of 10 and 17 mW without and with external magnetic field of B=0.9 Tesla.

Findings: Investigations showed an essential decrease of stored lattices erasure during readout in external magnetic field which shows the nearly exponential decrease of diffraction efficiencies η depending on erasure time for B=0; 0.9T and different readout beam powers. Erasure constant for magnetic field assisted readout of stored hologram by 17 mW beam shows 5 times increase from 180 to 900 secs at η maxe^{-1} level for B=0 and B=0.9T, respectively, due to magneto-photorefractive effect. The non-destructive photonic lattice structures are promising for different applications in all-optical devices.

rafael.drampyan@gmail.com