Multiplexed recording of dynamic gratings in bismuth silicate crystal by laser pulses

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Multiplex recording of holograms is a good method of storage and processing of optical information. The property of holograms, which makes it possible to record in a small volume a large amount of information about incident optical beams, makes it possible to obtain a high density of data on a small volume and to recover a particular hologram independently of the others.

In this work, a photorefractive crystal of bismuth silicate was used as a material for recording holograms. It belongs to the sillenite group and is a wide-gap dielectric with a large number of impurities and structural defects. The presence of the latter leads to the emergence of trap levels in the forbidden zone, recombination of electrons on which leads to the formation of holograms. The obtained holograms are dynamic, i.e. disappear with time and, due to the levels in the forbidden zone, can be obtained using radiation in the visible region of the spectrum.

Multiplexed holograms in bismuth silicate were recorded using the second harmonic of a pulsed Nd:YAG laser, and recovery was performed using a continuous 660 nm semiconductor laser. Laser pulses in the crystal formed holographic gratings with periods of 500 nm and 5 μm, respectively, and an additional delay was created between the beams recording the gratings in order to exclude the formation of additional cross gratings.

Determination of the topological charge of a phase singular beam using a nematic liquid-crystal Fresnel lens

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Currently, many scientific groups are engaged in the study of phase singular beams carrying orbital angular momentum due to the active use of topological charge for the implementation of qudits (multilevel quantum states) in cryptography, quantum information and communication. A simple interference method for analyzing the phase topology of optical vortices based on the preliminary diffraction of singular light beam on an achromatic electrically controlled nematic liquid crystal cell, which is a Fresnel zone plate, is proposed and implemented here. The efficiency of the method has been tested experimentally and theoretically in the visible and near-infrared range. The use of an electrically controlled achromatic Fresnel lens based on a nematic liquid crystal in singular optics offers a promising method for determining the topological charge of a phase singular light beam due to the possibility of analyzing signals coming from free space in real time without changing the circuit based on the possibility of switching on/off the proposed element. The developed method will help expand the scope of application of phase singular beams and significantly simplify existing technologies.

Numerical simulation of metal melting within the framework of a two-temperature model

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Physical, mathematical and 3D numerical models of laser-induced heating and melting process of metals have been developed. Simulations have been performed is the framework of a two-temperature model (for electron gas and ion lattice) and can be used to describe the melting process of metals under action of ultrashort (femto- and picoseconds) laser pulses with various spatial structures. The nonlinear dependence of the thermophysical parameters of the electron gas and ion lattice on temperature is also taken into account in the numerical calculations.

Simulation of a-Si-Au composite modification by a nanosecond laser pulse

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This study considers the numerical modeling of laser heating of composites and is conducted to analyze the temperature dynamics in thin films of amorphous silicon with a 130 nm thickness, with and without a 30 nm gold layer. Using finite difference methods to solve the heat conduction