 

*PHOTONICS AND NANOTECHNOLOGY*

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# Photonics and nanotechnology

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This issue of 'Quantum Electronics' contains studies of several research teams devoted to the interaction of laser radiation with matter. They consider the nonequilibrium processes leading to nanoscale modification of the properties of condensed matter. The effect of short and ultrashort laser pulses on the solid surface is accompanied by the formation of self-organising micro- and nanostructures. Specifically, structures with a spatial period that is absent in the laser beam profile on the target surface are formed on the irradiated area. The formation of nanostructures on the surface of irradiated solids is accompanied by a change in their optical properties, wetting angle, etc. Laser irradiation of metals is generally characterised by high cooling rates of the molten layer. It is shown that this leads to surface amorphisation in some cases.

The issue contains a review of studies devoted to the formation of nanostructures by nanosphere lithography. The problem of limiting spatial resolution of laser nanostructurisation at laser polymerisation and three-dimensional optical data recording is considered. Two-photon processes initiated by femtosecond laser pulses make it possible to implement unprecedently high data recording densities. The formation of three-dimensional nanocomposites under laser irradiation of polymers is analysed.

The processes of formation of micro- and nanocavities in transparent materials are theoretically considered. The pressure in such cavities and its dependence on the laser pulse width are estimated. The surface charge of dielectrics and Coulomb breakup upon photoexcitation of transparent dielectrics are investigated. The propagation of laser radiation in transparent media is modelled using the nonlinear Schrödinger equation.

The review of the studies on the formation and modification of nanoparticles by laser ablation of solid targets in liquids contains analysis of the properties of bimetallic nanoparticles, quantum dots, and doped oxide nanoparticles obtained under single- and double-pulse laser irradiation.

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A microscopic theory of optical properties of nanocomposites, which takes into account the interaction of randomly distributed nanoinclusions at their high concentration in the matrix, is developed. Analytical expressions are obtained for the field distributions inside and outside the nanocomposite medium. These results are in good agreement with the experimental data.

New experimental data on nanostructurisation of metals ablated by pico- and femtosecond laser pulses in liquids are presented. The size of nanostructures depends on the laser pulse width and the energy density of laser beam on the target. The size distribution of nanostructures is generally bimodal.

The condensation of nanoclusters under laser ablation of binary semiconductors in vacuum is experimentally investigated. The dependence of the cluster stoichiometry on the experimental parameters is analysed. Possible applications of these clusters in optoelectronic devices and nanolasers are discussed.

The laser transfer of diamond nanoclusters to different substrates is experimentally studied, and the thermal deformation mechanism of this process is discussed.

Several studies in this issue are written in cooperation with researchers from leading European laboratories. High scientific level of the materials presented is obvious. The processes investigated can undoubtedly be widely used in photonics, medicine, and biology.