

Short-pulsed laser production of nanomaterials: clusters, nanoparticles, and periodic surface structures

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A change in the structure of a material under the action of laser radiation can occur if the energy of light, transmitted to some area of the material, exceeds the energy of interatomic bonds in this area. The magnitude of the excess and the time, during which the energy is transferred, are both important. If the duration of the laser pulse is longer than the time of thermal relaxation, then this area of the material melts and evaporates – nanosecond laser ablation occurs. If the power of the laser pulse is high enough (short duration and high intensity), then electronic nonequilibrium processes start to rule: pico/femtosecond laser ablation takes place. Laser ablated substance consists of hot ions and fragments of the material. Upon cooling, they condense into clusters and nanoparticles (NPs). Besides, under particular conditions the laser induced periodic surface structures (LIPSS) occur on the ablated surface.

Our research is mostly performed on the basis of the Center for Collective Use of Equipment of NAS of Ukraine “Laser femtosecond complex” at the Institute of Physics of NAS of Ukraine. The radiation of Ti:Sa laser system (150 fs, 2 mJ, 1 kHz, 800 nm) is sufficient for ablation of almost any material. Produced LIPSS were visualized by SEM Aura 100, while the morphology of the NPs was studied by TEM-100M. Size of the NPs was checked by a homemade DLS setup. In the report, practical and physical aspects of short-pulsed laser formation of different nanomaterials will be presented.

Topics

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Primary author: Dr DMYTRUK, Andriy (Institute of Physics of NAS of Ukraine)

Presenter: Dr DMYTRUK, Andriy (Institute of Physics of NAS of Ukraine)

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