Fyzikální ústav AV ČR, v. v. i.
Na Slovance 2
182 21 Praha 8
hilase@fzu.cz
www.hilase.cz

Oddělení diodově čerpaných laserů, sekce výkonových systémů,
a realizační tým projektu HiLASE
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Ultrashort laser processing of solids. Numerical investigation of sub-wavelength optical and thermal effects in nanomaterials

Dr. Thibault Derrien

BAM Federal Institute for Materials Research and Testing, Berlin, Germany

Processing of solids with ultrafast laser pulses allows to functionalize matter via nanostructures formation, to analyze a wide variety of materials, and gave birth to various applications which require deep physical understandings. In this talk, two main regimes of laser intensity are considered. Processing of silicon slab samples upon 800 nm femtosecond laser pulses in ablation regime leads to the formation of various nanostructures located at the surface of the sample. It is demonstrated that transient modification of silicon optical properties leads to the excitation of Surface Plasmon Polaritons (SPPs), and quantitatively explain the formation of near-wavelength periodic structures ripples ("Low Spatial Frequency LIPSS") appearing during the first pulses, confirming the ultrafast modulation of the deposited energy and the role of electromagnetic surface waves. Additionally, a new thin film SPP model has been proposed and explains the formation of 100 nm periodic structures in water. Laser-assisted Atomic Probe Tomography (LaAPT) allows to analyze the lattice structure of various materials (metals, semiconductors and insulators) in three dimensions with an atomic resolution. The technique consists in a polarized silicon nanotip of which surface atom evaporation is triggered by low intensity laser irradiations with various wavelengths. The proposed model focuses on considering the effects of the nanotip geometry and opens a way to quantify thermal and optical effects of nanostructured materials upon femtosecond laser irradiation.

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