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Advanced ultrafast laser based methods for material micro/nano-structuring and time-resolved studies of nanostructures and reduced dimensionality systems

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Novel laser based methods are currently a hot subject of research as an alternative path towards development of nanostructures in bulk materials and on surfaces of materials. The subject of the ongoing research is the phenomena taking place during laser surface interaction and the potential in creating structures which may give additional functionalities to the material surface. The use of ultra fast lasers with temporally shaped pulses has been a novel methodology in the exploration of the potential in creating novel nano structures that could not have been accessed with traditional laser irradiation of surfaces. In this presentation, author will review the work of his group where he has demonstrated the employment of temporally shaped laser pulses to finely tune tweak the surface morphology (i.e., the grown nanostructures and their characteristics) through a non standard interaction of the incident laser pulses with the irradiated surface. This is a result of numerous fundamental physical processes ranging from the femtosecond to the nanosecond temporal window and are triggered by the temporal regulation of the energy deposition of the laser energy onto the under study surface. The manifestation through the creation of laser induced periodic surface nano-structures and the tuning of their morphological characteristics, e.g., spatial frequency and contrast will be the central part of the discussion. Further, he reviews work on applying time resolved pump prove laser spectroscopy in order to characterize and study the modified ultra fast electronic phenomena and interactions that take place on nano structured surfaces, reduced dimensionality quasi two dimensinal systems and more complex three dimensional metallic nanostructures.

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