



University of Crete
Department of Physics

Physics Colloquium

Thursday, 28 February 2019 | 17:00 – 18:00, Seminar Room, 3rd floor

Applications of Ultrafast Laser Materials Processing and Diagnostics

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ABSTRACT

This presentation will focus on the application of ultrafast photonic processes for novel materials synthesis, as well as for the development of novel photonic techniques to probe at the nanoscale, which are issues of great interest in current materials science and engineering research [Adv. Mat. 29, 1700335 (2017)].

In particular, Nature inspires us in tailoring unique surface properties based on synergetic effects of chemical composition and multiscale surface morphology. We show that highly controllable, biomimetic structures, exhibiting multifunctional water repellent, anti-reflection, friction reduction and photoresponsive properties can be directly written on metallic and dielectric surfaces upon processing with femtosecond laser beams of tailored polarization [Adv. Mat. 20, 4049 (2008) ; Biomicrofluidics 5, 013411 (2011)]. It is shown that such biomimetic laser structuring is a versatile approach to tune neuronal cell adhesion, proliferation and orientation and can be promising for biomaterial scaffolds for neural tissue regeneration [Biomaterials 67, 115-128 (2015)].

The second part of the presentation will focus on the application of advanced ultrafast laser based techniques for the synthesis and diagnostics of materials and components in photovoltaic, chemical sensing and energy storage systems. Specifically, the pulsed laser assisted fabrication of transparent graphene electrodes and interlayers for photovoltaic devices, is demonstrated [Adv. Func. Materials 25, 2213 (2015)]. Furthermore, we present a fast, non-destructive and roll-to-roll compatible photochemical method for the doping of graphene [Nanoscale 6, 6925-6931(2014)] and transition metal dichalcogenide (TMD) crystals [2D Materials 6, 015003 (2018)]. Finally we present our recent advances in the synthesis [Nanoscale 9, 18202 (2017)] and femtosecond laser spectroscopic diagnostics of perovskite and TMD nanocrystals. Application in sensors and energy storage systems [Nanoscale 2018, DOI: 10.1039/C8NR10009H] are demonstrated and discussed.