

Wavelength-selective ultrashort laser processing of dielectrics and semiconductors

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The current advent of new femtosecond laser technologies delivering high pulse energies in new spectral regions re-opens an important debate on the achievable performances for precision processing. In this presentation, it will be presented a comprehensive study on the superficial modifications in dielectrics and semiconductors exploring laser wavelengths covering a large spectral range (UV to MIR).

In the first part, understanding and control of spatial resolution aspects will be shown. Among other topics, it will be demonstrated that the concept of nonlinear resolution, highly exploited in multiphoton microscopy, is not applicable for femtosecond laser processing (e.g. ablation or amorphization) [1].

In the second part, laser-induced topographies in dielectrics and silicon together with its physical origins will be shown. For dielectrics, a counterintuitive quasi-invariance of material response in strongly varying nonlinear interaction processes is observed, which is supported by simulations considering different excitation mechanisms (multiphoton, tunneling and avalanche) and dissociation energies [2]. For silicon, mid-infrared pulses are demonstrated to be beneficial to form thick amorphous layers, making an important step towards the requirements for direct laser writing of all-silicon photonic circuit [3].

References:

- [1] M. Garcia-Lechuga, O. Utéza, N. Sanner, D. Grojo, *Optics Letters* 45, 952-955 (2020).
- [2] M. Garcia-Lechuga, O. Utéza, N. Sanner, D. Grojo, [arXiv:2212.10326](https://arxiv.org/abs/2212.10326) (2023)
- [3] M. Garcia-Lechuga, N. Casquero, A. Wang, D. Grojo, and J. Siegel, *Adv. Opt. Mater.* 9, 2100400 (2021).

Bio:

Mario García Lechuga holds a BSc and MSc in Physics (2012) from Universidad de Valladolid (Spain) and a PhD in Advanced Materials (2017) from Universidad Autónoma de Madrid. His PhD work, under the supervision of Dr. Solis and Dr. Siegel at the Instituto de Óptica CSIC (Madrid, Spain), focused on the development of time-resolved imaging techniques applied to femtosecond laser material processing. He worked later as a postdoctoral researcher at CLPU (Salamanca, Spain) and at LP3-CNRS (Marseille, France), and as an Applied Physics Assistant Professor at the Universidad Autónoma de Madrid. Currently, he is a tenured researcher at Instituto de Óptica CSIC, where is working on novel strategies for the understanding and the controllability on volumetric laser-induced modifications in materials.