PhD thesis proposal

Funded by Spanish Ministry of Science and Universities

Title: Advanced Laser Processing Techniques for the Optimization of Material Spectral Properties

Laboratory: Laser Processing Group, Instituto de Óptica, CSIC (Madrid) https://lpg.io.csic.es/
Supervisors: Mario García Lechuga and Jan Siegel
Funding: Spanish Ministry of Science and Universities
Gross monthly salary (approx.): 1600 € (1 year), 2000 € (2, 3 y 4 year).
Benefits: 4-year contract and funding for a short research stay in another laboratory
Estimated starting date: November 2024 – March 2025

Abstract: Laser processing includes various techniques that allow for precise structuring and functionalization of materials. Because of its flexibility (e.g., type of material, type of change, laser source), it has many applications in areas like plasmonics, tribology, and biology.

The overall objective of this thesis is to control and tune the spectral properties of materials of interest in photonics and sensing through femtosecond laser-induced structuring. Specifically, the two scientific goals are: increasing light absorption in the infrared range by microstructuring and hyperdoping of semiconductors, as well as fabricating spectrally selective filters (visible and infrared) by controlled transformation of nanocomposites (NP reordering and reshaping). The technological objective will consist of a proof of concept of a spectrally selective detection system.

The thesis framework is part of the activities of the HyperSpec project (Laser structuring and hyperdoping synergies for spectrally selective devices - PID2023-148178OB-C22), in close collaboration with the Thin Films and Microelectronics Group at Complutense University of Madrid.

Requirement: Holding the necessary qualifications (300 ECTS, Bachelor's + Master's degree) to enroll in a PhD program in Physics or Materials Science in a Spanish University.

Required profile: Person with a strong motivation in experimental work with lasers, solid knowledge in optics and laser-matter interaction, experience in material characterization techniques (microscopy, spectroscopy, Raman, AFM, etc.), and excellent oral and written communication skills.

Related bibliography:

[1] M. Garcia-Lechuga, N. Casquero, A. Wang, D. Grojo, and J. Siegel "Deep Silicon Amorphization Induced by Femtosecond Laser Pulses up to the Mid-Infrared" **Advanced Optical Materials** (2021). https://doi.org/10.1002/adom.202100400

[2] S. Algaidya, D. Caudevilla, F. Perez-Zenteno, R. Garcia-Hernansanz, E. Garcia-Hemme, J. Olea, E. San Andres, S. Duarte-Cano, J. Siegel, J. Gonzalo, D. Pastor, A. del Prado, "High-quality single-crystalline epitaxial regrowth on pulsed laser melting of Ti implanted GaAs", **Materials Science in Semiconductor Processing** (2023) https://doi.org/10.1016/j.mssp.2022.107191

[3] J. Doster, G. Baraldi, J. Gonzalo, J. Solis, J. Hernandez-Rueda, and J. Siegel, "Tailoring the surface plasmon resonance of embedded silver nanoparticles by combining nano- and femtosecond laser pulses", **Applied Physics Letters** (2014) https://doi.org/10.1063/1.4871507

[4] I. Solana, M.D. Ynsa, F. Cabello, F. Chacón-Sánchez, J. Siegel, and M. Garcia-Lechuga, "Optoplasmonic tuneable response by femtosecond laser irradiation of glass with deep-implanted gold nanoparticles", **Materials Today Nano** (submitted 2024)

Contact:	Inquiries and submission of applications (CV and cover letter) to: Mario García Lechuga (mario.garcia.lechuga@csic.es) Jan Siegel (j.siegel@io.cfmac.csic.es)

CALLE SERRANO, 121
28006 MADRID, ESPAÑA
TEL: (34) 91 561 68 00