SYEC 1: Laser-Based Micro-/Nanostructuring for Environmental Challenges

Time: Tuesday 11:00–12:25 Location: ELP 6: HS 1

Introduction to 'Lasers and Photonic Technologies for Environmental Challenges'

Invited Talk SYEC 1.1 Tue 11:10 ELP 6: HS 1

Nanostructured optical waveguides inside YAG crystals as a crucial step towards the development of microlasers for advanced sensing applications — •Omar de Varona[1,2], Franzette Paz-Buclatin[1], Paul Santos[1], Pablo Molina[3], Leopoldo Martín[1,2], and Airán Ródenas[1,2] — [1]Department of Physics, University of La Laguna, 38200 Santa Cruz de Tenerife, Spain — [2]Instituto Universitario de Estudios Avanzados en Física Atómica, Molecular y Fotónica (IUDEA), University of La Laguna, 38200 Santa Cruz de Tenerife, Spain — [3]Departamento de Física de Materiales, Instituto de Materiales Nicolás Cabrera and Condensed Matter Physics Center (IFIMAC), Universidad Autónoma de Madrid, 28049 Madrid, Spain

Nanophotonics stands as a pivotal technology to fight climate change, offering diverse solutions across multiple disciplines. Recent advancements in fabrication processes have enabled spectrum engineering, plasmonic nanoparticles techniques and miniaturization of light-trapping and guiding structures. These innovations equip researchers with novel tools for applications spanning from CO2 capture and enhancement of solar energy harvesting efficiency, to precise detection of pollutants for air and water monitoring. This presentation delves into the fabrication process of 3D nanostructures within crystalline materials tailored for photonic applications by means of femtosecond laser lithography. We report our latest results on the production of waveguides embedded in YAG crystals as a crucial step towards the development of microlasers for advanced sensing applications.

Invited Talk SYEC 1.2 Tue 11:40 ELP 6: HS 1

Laser surface modification of graphite anodes for lithium-ion batteries with improved fast-charging capability — •Max-Jonathan Kleefoot[1,3], Jens Sandherr[1], Jiri Martan[2], Volker Knoblauch[1], and Harald Riegel[1] — [1]LaserApplicationCenter (LAZ), Aalen University, Beethovenstraße 1, 73430 Aalen, Germany — [2]New Technologies Research Centre (NTC), University of West Bohemia, Plzen, Czech Republic — [3]Department of Machining Technology, Faculty of Mechanical Engineering (FST), University of West Bohemia, Pilsen, Czech Republic

In order to fulfil the high energy density requirements of lithium-ion batteries used in battery electric vehicles, electrodes with high active mass loading and low porosity or high compaction are required. However, such high-energy electrodes have a significantly lower rate capability, which is mainly a consequence of the limited lithium-ion diffusion. Laser-based microstructure adaptations can help to partially overcome the conflict of objectives between energy and power density. Various approaches such as the selective removal of binder components on the surface or the perforation of the electrode layer as deep structuring were investigated for this purpose. The aim of the work was to gain a better understanding of the machining processes but also to investigate the resulting performance of the electrode. It could be shown that the investigated processes lead to an significantly improved electrode performance in the fields of fast charging capability, wetting and lifetime compared to unprocessed electrodes.

SYEC 1.3 Tue 12:10 ELP 6: HS 1

Ultrashort pulse laser surface nanostructuring and its application — •Pierre Lorenz, Joachim Zajadacz, Martin Ehrhardt, and Klaus Zimmer — Leibniz-Institut für Oberflächenmodifizierung, Leipzig, Deutschland

Ultrashort pulse laser radiation can be used to irradiate metal surfaces and create self-organized micrometer and nanostructured surfaces. The surface morphologies depend on various laser parameters, including laser power, scan speed, wavelength, and repetition rate. In addition, the nanostructures can be transferred to an arylate surface using UV nanoimprint lithography (UV-NIL). The directly lasered or molded surfaces exhibit interesting optical, electrical, and fluidic properties. For example, laser-assisted nanostructuring of copper surfaces allows the fabrication of Cu surfaces with adjustable secondary electron yield. Similarly, laser-assisted nanostructuring of stainless steel surfaces allows the water contact angle to be adjusted from superhydrophobic to superhydrophilic. In addition, the forming of nanostructured surfaces allows the production of surfaces with adjustable optical reflectance. This presentation provides an overview of laser-assisted nanostructuring of surfaces and its applications.