SYEC 2: Fiber-Based Plasmonic Microreactor for Flow Chemistry

Time: Tuesday 14:00–15:30 Location: ELP 6: HS 4

Invited Talk SYEC 2.1 Tue 14:00 ELP 6: HS 4

Development of soft glass optical fibers based on 3D printed preforms — •Ryszard Buczynski[1,2], Pawel Wiencław[2,3], Przemyslaw Golebiewski[1,2], Dariusz Pysz[1], Adam Filipkowski[1], Grzegorz Stepniewski[1], Olga Czerwinska[3], and Andrzej Burgs[3] — [1]Lukasiewicz Research Network, Institute of Microelectronics and Photonics, Al. Lotnikow 32/46, 02-668 Warsaw, Poland — [2]Faculty of Physics, University of Warsaw, Pasteura 5, 02-093 Warsaw, Poland — [3]Sygnis S.A., Al. Grunwaldzka 472, 80-309 Gdansk, Poland

We report on the development of a 3D printing system dedicated to the development of soft glass optical fiber preforms. In contrast to previous studies on 3D printing of optical fiber preforms, the proposed process is based on the deposition of straight, horizontally oriented lines to replace the manual stack-and-draw fiber assembly process. The printer consists of a miniaturized crucible for melting glass blocks and a pneumatic extrusion head. Developed in-house heavy metal oxide glass was used to print the preform. The proposed 3D glass printing system is recognized as green technology, as it significantly reduces glass waste compared to standard stack-and-draw methods, and does not use difficult-to-recycle polishing powders in the fabrication process. As a proof-of-concept, a microstructured fiber preform with a solid core and 3 rings of air holes was printed. The fiber preform was composed of 2500 microrods. The total dimensions of the preform were 60x25x25 mm. Next, the final fibers are drawn at the fiber drawing tower and further characterized. The optical quality of the glass is maintained during the process and no crystallization is observed. The proposed 3D printing method is very promising for automating development process of microstructured fibres and free-form optical components. Since there are no restrictions related to the symmetry or circular shape of the printed fiber preform, this method can be applied to develop new types of fiber optic sensors and flow-through micro-optofluidic systems.

Invited Talk SYEC 2.2 Tue 14:30 ELP 6: HS 4

Three-dimensional Ultrashort-Pulse Laser Nanolithography of Optical Materials — •Airán Ródenas[1,2], Omar de Varona[1,2], and Franzette Paz-Buclatin[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

In this talk we will discuss our recent results on 3D ultrashort pulse laser nanolithography of optical materials towards novel optical instrumentation for harsh-environments. We will present recent results on the understanding of the photomodification processes in optical crystals on different irradiation dose accumulation regimes. We will also discuss the microstructuring of hollow optical fibers towards novel optofluidic micro-reactor systems.

Invited Talk SYEC 2.3 Tue 15:00 ELP 6: HS 4

Fibre-based plasmonic micro reactor CO2 reduction — •Devin O'Neill, Patrick Spath, and Wiebke Albrecht — AMOLF, Amsterdam, The Netherlands

As part of a bid to achieve carbon neutrality or even atmospheric remediation of CO2 levels new, sustainable, and efficient technologies are needed. The EU "reaCtor" project aims to combine the chemical selectivity of a flow microreactor with plasmon-induced photocatalysis in a highly efficient light guiding system - a hollow core optical fibre with annular light propagation; capitalizing on short lived (0.1-1 ps)[1] hot-electrons generated with plasmon relaxation to drive CO2 reduction to useful products[2]. We strive to unify disparate literature in a highly photon-efficient photocatalytic system. Here, we show work on surface enhanced Raman scattering from a single nanoparticle for CO2 reduction where the hot electron is extracted by imidazolium[2] binding CO2 and driving the chemical reaction[3] with the restrictions of the optofluidic environment.

[1] Nature Nanotech (2015), 25-34, 10(1), [2] Nature Comm (2019), 1-7, 10(1), [3] J. Phys Chem. C (2021), 17734-17741, 125(32)

This project has received funding from the EIC program under grant agreement No 101099405.