LAPHIA
Laser & Photonics
in Aquitaine

université de BORDEAUX

Cluster of Excellence LAPHIA
Seminar

« Novel fabrication approaches of nanostructured photonic systems within one-dimensional fibers and two-dimensional large-area flexible substrates »

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Auditorium - Institut d'Optique d'Aquitaine - Talence
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Abstract:

Many surface properties of materials can be tailored by a proper physical texturing. Such patterning, especially when involving materials with different properties and organized at the micro- or nano-scale, can be exploited for light management in advanced photovoltaic systems, in optical metasurfaces, but also to tailor the hydrophobicity of surfaces, to enable the preferential positioning and growth of biological cells, or to generate turbulences in confined micro and nanofluidic channels. All these examples require however to fabricate such patterns over large area substrates, over flexible surfaces with small curvature radii, or even within confined 3D hollow cavities. While the advancement of wafer-based techniques has enabled the fabrication of high quality nanostructures, it remains rather complex and expensive, and very challenging to achieve the same level of quality beyond small, flat and rigid Silicon substrates.

In this talk, we will present innovative, simple and scalable approaches to self-organize complex multi-material nanostructures over two-dimensional large-area flexible substrate or one-dimensional fibers and ribbons. In particular, we will first show how we can control the solid-state dewetting of thin, high refractive index optical glass layers onto patterned polymer substrates to realize optical metasurfaces. We will investigate how the interplay between the viscous flow at the nanoscale and intermolecular forces enable to tailor the size and shape of chalcogenide glasses nano-objects and hence control their optical properties. Second, we will present how we can apply similar principles to the process of thermal drawing – the same process used to fabricate optical fibers – to realize multi-material fibers and ribbons with unprecedented functionalities. In particular, we will show how we can fabricate thin and flexible fibers and ribbons with sub-micrometer surface patterns. We will show how these fibers can be used to impart surfaces and fabrics with unprecedented optical, hydrophobic, microfluidic but also biological functionalities. By integrating other materials such as semiconductors and metals inside such structured fibers, we will demonstrate the potential of multi-material fibers for new types of fiber sensors, smart textile, and optical fiber probes.

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