Micro- and nano-structured materials for photonics

Context

The research project focus on the research of new materials for photonics. Among all the technologies of photonics, the development of integrated photonic circuits (noted PIC for Photonic Integrated Circuits) is growing strongly. This type of technology affects and will affect more and more economic areas such as telecommunications, security, military and health. For instance, the quantum technology development relies on the capacity of realizing integrated optical circuits. Future developments in this field require controlling the material properties and their integration.

Research project

The postdoc offer concerns the fabrication and characterization of micro- and nano-structured photonic materials. Glass turns out to be a material of choice thanks to its intrinsic transparency if we can locally control the optical properties in 3D (refractive index, absorption, emission) at different scales: on the micron scale corresponding to, but also on few tens of nanometers. 2D/3D nano-structuring will allow developing artificial materials with new or enhanced properties necessary for integrated optics. It would open the way to “freeform” optical systems that will combine different functions in a single component. Recently, several research groups have demonstrated that Laser glass interaction using specially designed photosensitive materials is a promising approach for developing 3D structured optical components.

Different approaches for 3D printing of optical components have been developed, including: (i) Light Exposure-Based Additive Technologies: Light interacting with photosensitive materials can be exploited to produce patterns with micrometric or sub-micrometric resolution; (ii) 3D Printing by Extrusion: 3D printing by extrusion of materials allows consecutively depositing layer based objects; (iii) Solution-Based technology: Printing of 3D silica based objects with the use of silica nanoparticles dispersed in organic monomers or polymers was reported by stereolithography followed by high temperature treatment for the organic components removal. Despite the progress achieved, these methods failed to address critical issues: (i) keep optical properties of the materials, (ii) maintain the spatial resolution required for manufacturing optical components. Among the different approach 3D structuring by laser in the volume of photosensitive materials remains the best approach for insuring high optical quality of the resulting optical component.

The project proposed will focus on the development of adapted novel photosensitive oxide glass for fabricating 3D structured photonic component. The candidate will be part of a multidisciplinary consortium gathering physicists specialist in femtosecond laser interaction and chemists aiming to develop photosensitive materials and 3D structure. The post doctoral position will focus on the development of photosensitive materials and the characterization of photo-induced 3D structures written by Laser.

Main aspects developed during the project:

- Synthesis of new glass compositions
- Physicochemical and structural characterizations.
- Study of material modifications by laser irradiation.
- Characterization of micro-structuring induced by different microscopy techniques (Raman, luminescence, interferometry, AFM, electron microscopies (SEM, TEM, EDS, Auger)).

Institute

The Bordeaux Institute of Condensed Matter Chemistry (ICMCB) is a joint research unit (UMR5026) of the CNRS, the University of Bordeaux and Bordeaux INP. With its scientific expertise in solid state chemistry, materials science, and chemistry & processes, the ICMCB is involved in the development of new concepts in material chemistry and physics, to synthesize, shape, investigate and recycle emerging materials for energy, for environment and health and for electronics and photonics.

Profile

PhD in chemistry and/or material science

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Funding

12 months post doc

Funding agency : University of Bordeaux, Program of excellence

Starting date : November 1st, 2024

How to apply

For the application, please provide :

- Letter of application (cover letter),
- CV
- List of publications

References

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