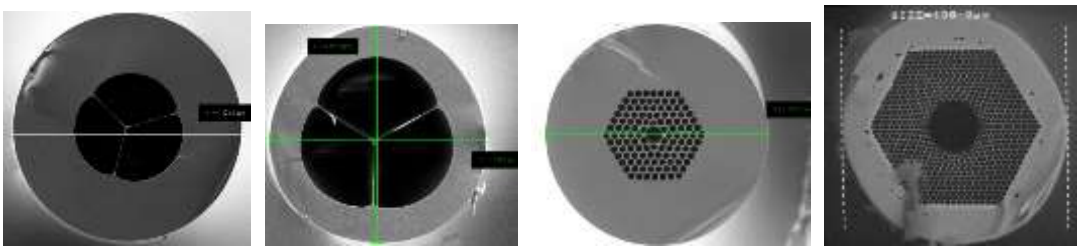
DESCRIPTION FOR GENERAL PUBLIC

Optofluidics synergistically merges technological advances in the photonics with microfluidics enabling a broad range of novel applications, including fluidic-controlled photonic devices (e.g. optofluidic lens and fluidically tunable resonator) and renewable energy solutions. Optofluidic microsystems designed to work with aqueous solutions or aqueous cell suspensions maximize the interaction of light with particles in water. This unique feature can be exploited to develop better optofluidic biochemical sensors or novel bio-inspired photonic devices such as bio-lasers which use biological materials/cells as components of a photonic device.
The goal of the project is to study properties of new type of fibre lasers where the active medium are various types of active liquids, such as chemical dyes, fluorescent proteins and bacteria. Fibre based optofluidic lasers are a new type of light sources. Recently they attracted interest due related to the progress in the development of new types of luminescent organic dyes mainly aimed for biomedical applications (cell marking). Also, the progress in DNA modified bacteria brings into the market new type of active media. The new active materials promise to overcome the main limit of current dye lasers – the photobleaching. Moreover, optofluidic active media do not have a discrete, well defined band structure as in the case of Er or Tm doped glass. In the case of optofluidic fibre laser we witness a complex band structure. Therefore the study of laser configuration and resonator properties is needed.

In the scope of the project we plan both theoretical and experimental research work. Most of the research will be devoted to fibre structures modeling and development, their characterization and experimental verification of fibre laser properties in different resonator configurations. Also study of various active media will be carried out within the project.



Photonic crystal fibers dedicated to optofluidic applications developed in ITME

Development of macroscopic fiber lasers with biological gain media is a completely new area of research with no existing literature reference. Our project team will uniquely combine expertise in PCFs and in optofluidic lasers. The fiber-bio-laser demonstrations will inspire new concepts in biochemical sensing and biologically controlled light sources. Recently, optofluidic lasers were shown to increase the performance of fluorescence energy transfer (FRET)-based biosensors. For instance, DNA nanostructures (such as DNA tetrahedron or DNA origami) or enzymes are used to control the laser gain, thereby modulating the laser output power and the output wavelength in FRET-based lasing. In a similar manner, fiber-bio-lasers will enable the development of novel FRET-based biosensors.