WYKŁAD

w ramach programu IDUB Mentor

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„Some Applications in Optofluidics and Biological Imaging"

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Wydział Fizyki UW, sala B4.58

Abstrakt

In this talk, I will summarize the recent research projects we have been pursuing on Optofluidics and Biological Imaging.

Fluids possess unique properties for designing optical components and systems: (i) they have optically smooth interfaces and (ii) they provide great flexibility in shape and refractive index. Optofluidics has emerged as an exciting new research field employing these unique properties of fluids to design optical components and systems that cannot be realized with classical solid-state materials. We used plasma oxidation and laser ablation for static and reversible modifications of hydrophobic surfaces along pre-defined patterns. We employed such hydrophilically patterned surfaces for optofluidic waveguide and microdroplet sorting applications. We used manual drilling or mold replication to fabricate microchannels in silica aerogel blocks. Following a silanization step, these microchannels were filled with water and used as optofluidic waveguides. We have demonstrated photochemical reactions using these novel optofluidic waveguides. We achieved bulk refractive index sensing with a limit of detection of around 10-5 refractive index units using optical fiber resonators. The same system also gave us good hydrogen sensing performance upon palladium and polymer coatings.

On the topic of biological imaging, we built a light sheet fluorescence microscope for cleared tissue imaging, a structured illumination microscope using image scanning microscopy for super-resolution microscopy, and fiber bundle-based fluorescence imaging systems. Deep learning has triggered a revolutionary transformation in digital optical microscopy. Deep learning approaches that employ problem-specific deep neural network models have largely replaced standard image processing techniques such as thresholding and watershed transformation for processing optical microscopy images. In addition to data analysis, deep learning can also be used exquisitely to improve the overall performance of an optical microscope. Deep learning-enhanced approaches can be used to increase the signal-to-noise ratio, to obtain super-resolution images above the diffraction limit, or to create virtually stained images from images that do not contain any staining. I will discuss our recent works on novel deep learning-based solutions for automated cell counting and viability analysis, brain vasculature analysis, and improving the contrast and resolution of fluorescence microscopes.