BP 20: Novel Methods

Time: Wednesday 17:30–18:15 Location: H43

BP 20.1 Wed 17:30 H43

The optical cell rotator: An approach to single cell tomography. — •Moritz Kreysing[1], Anatol Fritsch[1], Tobias Kiessling[1], Jochen Guck[2], and Josef Käs[1] — [1]Institute for Soft Matter Physics, Universität Leipzig, Linnéstr. 5, 04103 Leipzig — [2]University of Cambridge, Department of Physics, JJ Thomson Avenue, Cambridge, CB3 0HE, GB

Although optical trapping techniques have become essential in the field of micromanipulation of biological samples during the last decades, all related attempts to control the orientation of biological cells perpendicular to the optical axis of a microscope were unsatisfactory.

With our work we present for the first time a laser tool to hold, continually rotate and stably orient individual biological cells. The so called "optical cell rotator" is based on a dual beam laser trap but due to a modified beam geometry extended by a potential for the cells' orientation. The generation of this potential could be achieved by the excitation of high order modes in a polarization-maintaining optical fiber resulting in a steadily transported asymmetric beam profile.

Experiments with erythrocytes and HL60 cells clearly show that suspended cells orient one-to-one correlated to a rotation of this laser beam almost instantaneously and can thus be observed under any angle. Our method combined with confocal laser microscopy and modern tomography software promises imaging of individual suspended cells and even separated cell organelles with isotropic resolution.

BP 20.2 Wed 17:45 H43

Nonlinear vibrational microscopy with coherent anti-Stokes Raman scattering — •Christoph Heinrich, Alexander Hofer, Stefan Bernet, and Monika Ritsch-Marte — Division for Biomedical Physics, Innsbruck Medical University, Müllerstraße 44 A-6020 Innsbruck, Austria

It is well known that the intrinsic ability of molecules to rotate and vibrate can be utilized to obtain spectroscopic resolution. Commonly used methods like Raman and infrared spectroscopy have, however, crucial shortcomings in microscopy. Infrared microscopy yields a lack of resolution due to the long excitation wavelengths whereas Raman microscopy does only deliver a weak signal. Coherent anti-Stokes Raman scattering (CARS) microscopy has emerged as new microscopic method a few years ago combining both, high resolution and an intense signal. High resolution is guaranteed through the blue shifted anti-Stokes signal making it also easy to separate it form the excitation laser beams and fluorescence by means of a short pass filter. The coherent signal is enhanced compared to the linear Raman effect due to stimulated emission and constructive interference in the direction determined by the phase matching condition. A drawback unfortunately is a frequency independent nonresonant background always accompanying the resonant signal. Wide-field CARS microscopy presented in this contribution is a non-scanning approach that allows high speed imaging. Latest results and prospects will be discussed.

BP 20.3 Wed 18:00 H43

Surface Plasmon Excited Nanolight Sources — •Dominic Zerulla, Brian Ashall, and Michael Berndt — UCD Dublin, School of Physics, Dublin 4, Ireland

Presented here is a project to develop novel apertureless nanolight sources which would find applications in many innovative devices. In particular, they will be the basis of novel lightsources which will combine beyond diffraction limit resolution with a currently unattainable high photon flux. In brief, the creation of these sources is based on the phenomenon of Surface Plasmon excitation on complex nanostructures. The topographic design of the nanostructures creates a 3-dimensional highly focused electromagnetic field distribution.

The tailor-made structure arrays have been designed on the basis of our theoretical predictions and have been fabricated using e-beam lithography. The layout of the individual nanostructures is not necessarily rotationally symmetric but can have a threefold symmetry axis or even more complex symmetry. The nanostructure are arranged in form of an array.

The light emission and Surface Plasmon resonances from these arrays are currently been investigated in the far-field and the near-field. Additionally, an investigation into the polarisation dependence of the intensities of the diffracted patterns from the above mentioned nanostructured arrays will be discussed. The generation of these highly focused, controllable and localized electromagnetic fields will permit currently unattainable imaging resolution to drive advances in the critical biomedical sector.