CARL VON OSSIETZKY universität OLDENBURG
Institut für PHYSIK

PHYSICAL COLLOQUIUM

INVITATION

Monday, 16.11.2020, 4.15 p.m.,

speaks

Dr. Sven Heiles,

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about

Mass Spec and beyond
"Revealing spatial and molecular complexity of biological samples by mass spectrometry and light"

There is an increasing appreciation that every cell, even of the same type, is different. This complexity, when additionally combined with the variety of different cell types in tissue, is driving the need for spatially resolved omics at the single-cell scale. Rapid advances are being made in genomics and transcriptomics, but progress in metabolomics, the research field that aims to comprehensively chart all biomolecules of low molecular weight, lags. This is partly because amplification and tagging strategies are not suited to characterize dynamically created metabolites. The inability to employ fluorescence probes also complicates the use of existing biophysical methods such as Förster resonance energy transfer or super-resolution microscopy. Mass spectrometry imaging (MSI) is an alternative means to localize and characterize molecules, especially metabolites, on biological surfaces. Until recently, however, lateral resolution and structural selectivity of MSI methods were not sufficient to benefit biochemical and biophysical research of single cell processes.

In my talk, I will present our contributions to the development of MSI as a structure-selective metabolite microscope with single cell resolution. For this purpose, the design and performance of newly constructed matrix-assisted laser desorption/ionization (MALDI) MSI ion sources operating at ambient pressure and temperature will be detailed. In combination with automated focusing through triangulation, these ion sources allow to reveal compound distributions with down to 1 µm lateral resolution, scan speeds of up to 18 pixels/s and tolerate sample height variations of up to 600 µm/pixel. The MSI developments are accompanied by our progress in designing structure-sensitive fragmentation methods. By harnessing photochemical derivatization, gas-phase UV irradiation and subsequent ion dissociation, aspects of the chemical structure of desorbed and ionized molecules are readily revealed. Combination of photochemical fragmentation and

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MSI even allows to track the location of distinct chemical isomers with single cell resolution. The capabilities of this bioanalytic method toolset will be showcased by imaging compound distributions in cell monolayers, tissue sections as well as intact multicellular organisms such as parasites and plants. In the final part of the talk, current obstacles and our efforts to achieve lateral resolutions below 1 µm and increased metabolite coverage will be outlined.

All interested persons are cordially invited.

Sgd. Prof. Dr. Sascha Schäfer