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LS-12-IN-6093 Molecular scales: Imaging signals of disease with mass spectrometry

Heeren R. M.[1,2]

[1]FOM-AMOLF, Science Park 104, 1098 XG Amsterdam, The Netherlands, [2]M4I, Maastricht University, Universiteitssingel 50, 6229 ER Maastricht, The Netherlands

Email of the presenting author: heeren@amolf.nl

Molecular microscopy is a field of many scales; length, size, color, thickness, weight and many more. The study of molecular signaling processes related to disease on each of those scales requires the detection and analysis of the molecules involved as well as the evaluation of their spatial organization. This allows the detailed molecular typing of cells under duress and can provide critical insight in the activated pathways related to the progression of disease. Molecular imaging in the post-genome era provides insight in metabolomic and proteomic changes during the progression of disease on different scales; from single cells to whole biological systems.

Multimodal molecular imaging with mass spectrometry provides direct insight into the spatial organization of a wide variety of molecules on complex surfaces. It is truly a multiplex and label free imaging technique that takes advantage of all analytical capabilities embedded in modern mass spectrometers. This molecular histology technique allows for direct structural analysis of molecules liberated from the surfaces under study. As such, it enables direct targeted and untargeted analysis of endogenous metabolites, oligosaccharides, lipids, peptide and proteins, as well as exogenous compounds. The subsequent identification and quantification can contribute to disease specific molecular disease profiles.

The distribution of several hundreds of molecules on the surface of histological tissue sections can be determined directly in a single imaging MS experiment. This enables molecular pathway analysis as well as the role of the different molecular signals and their behavior under a drastically changing chemical or biological environment in these pathways. Imaging mass spectrometry has evolved to bridge the gap between different disciplines such as MRI, PET, fluorescence imaging and histology. In this contribution we will discuss applications of new MS based chemical microscopes in biomedical tissue analysis in various diseases. This lecture will highlight innovative applications of multimodal imaging MS that elucidate the way in which local environments can influence molecular signaling pathways on various scales.