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Novel strategies for comprehensive spatial metabolomics

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Mass spectrometry imaging (MSI) is a powerful analytical tool with an increasing range of applications in life sciences. It combines traditional imaging methods with the advantages of untargeted mass spectrometric detection and identification of numerous classes of molecules, which allows for new insights into tissue samples by, e.g., the exchange of metabolites within the cellular micro-environment. A key element of the analysis is the overall efficiency of the ionisation, which aims towards a versatile and unbiased sampling without major fragmentation. Matrix-assisted laser desorption/ionisation (MALDI) is the most used technique for MSI of biological analytes. Based on untargeted, spatial chemical information, tissue samples can be analysed with superior density of information compared to conventional histology techniques. However, complex biological tissue samples impose significant challenges to MALDI-MSI due to the wide distribution of analyte abundances, polarities, and strong differences in the biochemical matrix of varying tissue types in close proximity.

In this talk, I will present new analytical strategies for comprehensive tissue characterization that we develop in the Metabolomics Interdisciplinary Laboratory of the University of Tarragona. This comprises, e.g., secondary ionization and new matrices based on photoactive metal nanostructures for spatial metabolomics that approach to mitigate ion suppression and low ion yields for low-weight and mid-polar molecule classes. Further, I will demonstrate our in-house developed versatile open-source R package rMSI, able to visualize, process, and analyze MSI data, and combine the data with complementary techniques such as RAMAN spectroscopy for multimodal analysis. I will finish with exemplary MSI analysis of biological and clinical tissue as a cost-effective means to monitor, e.g., patients, or to identify novel biomarkers to help the urgent need for prognostic and diagnostic means.

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