Laser Ablation-Based Bioimaging with Simultaneous Elemental and Molecular Mass Spectrometry: Towards Spatially Resolved Speciation Analysis

Christina Herdering, University of Münster, Corrensstr. 30, 48155 Münster

Mass spectrometry (MS) has been introduced as a promising tool for bioanalytical imaging in the recent years. Depending on the ionization method, MS provides information about the chemical identity of molecules or about the elemental distribution. The most common molecular MS imaging technology is matrix-assisted laser desorption/ionization (MALDI) MS, while laser ablation (LA) coupled to inductively coupled plasma (ICP) MS is a powerful method for elemental MS imaging of heteroatoms. MALDI-MS and LA-ICP-MS provide complementary molecular and elemental information, but they cannot be used simultaneously for the analysis of the same sample as different sample preparation techniques are required.

Here, a new MS based analytical method to gather simultaneously molecular and elemental information is presented. A 213 nm LA system is coupled in parallel to a molecular high resolution mass spectrometer with atmospheric pressure chemical ionization (APCI) and to an elemental mass spectrometer with an ICP as ionization source. This approach was proven with several solid samples including tissue slices of animal and human origin, tablets, thin layer chromatography cards and dried droplets. Target analytes were pharmaceuticals (e.g. paracetamol, cisplatin) and histological staining agents (e.g. eosin, hematoxylin).[1,2] To show the distribution of the target analyte, images for the non-fragmented pseudomolecular ions MH⁺ obtained by LA/APCI-MS and for the heteroatoms observed by LA/ICP-MS were created. Exemplarily, the histological staining agent eosin was examined in tissue slices of mouse organs including kidney and testicles. In LA/APCI-MS, the eosin molecules were detected as MH⁺ ions with a deviation of less than 2 ppm between the determined and calculated mass-to-charge ratio. [2] In LA/ICP-MS, the eosin distribution is reflected by the observed bromine. [2]