A high-resolution scanning microprobe MALDI ion source for imaging analysis on an ion trap / Fourier transform ion cyclotron resonance mass spectrometer

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A new scanning microprobe matrix-assisted laser desorption/ionization (SMALDI) ion source for high spatial resolution has been developed for linear ion trap and Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR-MS). The source is fully compatible with commercial ion trap flanges (such as the LTQ series, Thermo Fisher Scientific). The source is designed for atmospheric pressure (AP) operation but is also suitable for mid-pressure operation. The AP mode is especially useful for investigating volatile compounds. The source can be interchanged with other ion sources within a minute when operated in the AP mode. Combining high-lateral resolution MALDI imaging with high mass resolution and high mass accuracy mass spectrometry, available in the FT-ICR mode, provides a new quality of analytical information, e.g. from biological samples. First results obtained with the new ion source demonstrate a maximum lateral resolution of 0.6 by 0.5 µm. Depending on the limit of detection of the chosen mass analyzer, however, the size of the focus had to be enlarged to a diameter of up to 8 µm in the FT-ICR mode, in order to create enough ions for detection. Mass spectra acquired for analytical imaging were obtained from single laser pulses per pixel in all the experiments. This mode allows us to investigate biological thin sections with desorption focus diameters in the micrometer range, known to cause complete evaporation of material under the laser focus with a very limited number of laser pulses. As a first example, peptide samples deposited in microstructures were investigated with the new setup. A high quality and validity of the acquired images were obtained in the ion trap mode due to the low limit of detection. High mass resolution and accuracy but poorer image quality were obtained in the ICR mode due to the lower detection sensitivity of the ICR detector.