

Novel strategies for desorption mass spectrometry

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Development of new analytical instrumentation, sample preparation, sampling modes and sample introduction techniques related to matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI TOF MS) imaging and inductively-coupled plasma mass spectrometry (ICP MS) are presented.

MALDI TOF MS imaging is a rapidly evolving technique enabling the mapping of compounds present in biological tissue sections. Despite the recent introduction of high-repetition rate lasers to TOF MS instruments, obtaining a single high-resolution image requires a few hours. A substantial increase in the throughput of the TOF MS-based tissue imaging can be achieved by introducing of the new laser beam scanning sampling mode. In this mode, high-speed precision scanning of the laser beam along the imaged sample surface is used to overcome a slower sample target translation realized by motorized stages in MALDI TOF MS imaging. An axial MALDI TOF MS instrument utilizing a 4-kHz UV laser and high-speed optical scanning system was constructed in our laboratory. The instrument recorded a 100 × 100 pixel MS image in ~11 min using 100 laser shots per pixel. This is almost an order of magnitude faster when compared to a modern commercial instrument equipped with 1-kHz laser.

Matrix application to a surface of the biological tissues is a crucial step in successful MALDI imaging experiment. Several techniques of matrix deposition, namely airbrush deposition, electrospray deposition, nano-spotting and sublimation were developed. The most promising techniques were used for MALDI MS imaging of lipids in mouse brain tissue.

A diode laser thermal vaporization (DLTV) is a sample introduction technique to ICP, which presents a low-cost alternative to the commercial laser-ablation systems and nebulizers. DLTV employs a diode laser with power sufficient to induce ablation/pyrolysis of the substrate, typically a common filter paper overprinted with a black ink. Submicroliter liquid sample volumes are deposited without any treatment on the substrate, dried, vaporized in the laser ablation chamber and the generated aerosol is then carried into the ICP mass spectrometer. New substrate for DLTV, cellulose thin-layer chromatography (TLC) sheets was introduced and the coupling of ICP MS with the TLC separation will be discussed.

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