Optimizing laser incident angle for improved MALDI performance in molecular imaging mass spectrometry

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Molecular imaging mass spectrometry is used to reveal the relative distribution of peptides and proteins throughout a sample surface (biological tissue). Recording the distribution of elements and bio-molecules in cell and tissues will help to address many issues in today's cell biology and medicine. Matrix Assisted Laser Desorption/ionization (MALDI) mass spectrometry has been used for molecular imaging purposes decade ago to create a chemical images of substrates.

The conventional scanning technique of MALDI molecular imaging mass spectrometry is performed by ablating the entire sample surface with laser spots in a pattern of array. The pixel size of the image or the spot size of the laser beam is typically referred to as the spatial resolution in MALDI molecular imaging mass spectrometry. The laser spot size, focused on the sample surface is a major parameter in determining the spatial resolution. The variation of laser spot size on the MALDI target at different angles of the laser beam were studied in this research, analyzing the photographic images of laser burnt spots on a thin layer of 4-hydroxy-α-cyanocinnamic acid (α-HCCA) using the *Digimizer* software (trial version).

The commercialized two MALDI mass spectrometers, in which the laser beam incidents on the target at an angle of 30^o and 60^o with their mass spectrometer axis produced elliptical spots on the thin layer of α-HCCA . In this study, for different laser incident angles using a developed MALDI ion source analyzed the spots on the target. According to the results the ratio of minimum and maximum diameters of each elliptical laser spot were related to the cosine of their incident angle. When the laser incident angle on the target changes from 60^o to 0^o, the shape of the laser spot turned to circular with the minimum diameter. The maximum diameter of elliptical laser spot decreases in ~50% when the laser incident angle on the MALDI target changes from 60^o to 30^o, but it is about 15 % for the laser incident angle variation from 30^o to 0^o. Therefore the modification of MALDI ion source in order to improve the spatial resolution in molecular imaging mass spectrometry is less effective below the 30^o of laser incident angle on the target.