

OptiBeam™ On-Axis Laser Irradiation on the AB SCIEX TOF/TOF™ 5800 System

Orthogonal Sample Laser Irradiation in MALDI Mass Spectrometry Significantly Improves Sensitivity

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Since the introduction of Matrix Assisted Laser Desorption Ionization (MALDI) in 1985-881, various approaches have been used to try and understand the fundamental physics of this ionization process. When an incident pulse of laser light hits a crystalline preparation of matrix and analyte, neutral molecules and ions are desorbed as a plume into the gas phase. Several approaches have been applied to determine the shape of the distribution of the desorbed molecules, and its dependency on the surface or the incident of the laser pulse.

Influence of Laser Angle on the Spatial Distribution of Matrix and Biomolecules in MALDI Mass Spectrometry

The angular distribution of the MALDI ion plume was found to be directed back towards the direction of the incident laser 2,3. Aksouh et al. (1995) attributed this effect to the shape of the crater produced by laser ablation and the enhanced ion emission on the side of the crystal that is irradiated by the laser. Bökelmann (1995) came to the same conclusion when studying the ablation process during MALDI4. Results for standard dried droplet preparations show a distribution of desorbed molecules which is directed back towards the incident laser pulse due to

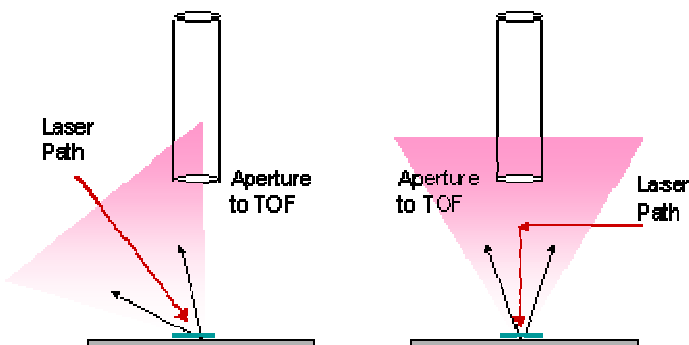


Figure 1. OptiBeam™ On-Axis Laser. By adjustment of the incident laser angle (red line) to on-axis laser irradiation on the 4800 MALDI TOF/TOF™ Analyzer and the TOF/TOF™ 5800 System, the optimum MS and MS/MS sensitivity (more ions directed into the TOF region, black lines and pink plume) was achieved.



asymmetrical illumination of the matrix material 5,6. For coarse crystalline preparations, a mixing of radial and axial velocity components occurs7, which also results in a distribution of ions and neutral particles back in the direction of the laser. A nearly symmetric angular distribution of the initial velocity only was found in the very interesting case of analytes desorbed from matrix single crystals7.

Results from Poretzky et al.8,9, who analyzed the plume expansion with laser-induced fluorescence, show a very broad and large distribution of neutrals that is slightly directed back towards the incident laser. Although this data shows an expansion plume several cm in size, this cannot be easily applied to conventional MALDI instruments with laser beams width of several.

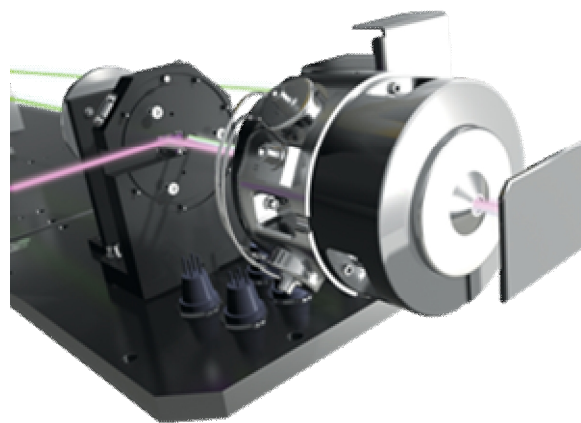


Figure 2. OptiBeam™ Laser with Programmable Self-Cleaning Source. After extensive LC MALDI acquisition, matrix and sample can build up on the source. Regular source cleaning keeps the instrument clean and operating at the highest sensitivity.

OptiBeam™ On-Axis Laser Irradiation

Adjustment of the incident laser angle on the 4800 MALDI TOF/TOF™ Analyzer showed that the optimum sensitivity was found with the on-axis laser irradiation. The ion plumes were uniformly dispersed back in the direction of the laser beam when using OptiBeam™ on-axis laser irradiation, leading to higher ion collection efficiency (Figure 1) in this axial TOF instrument. The laser runs at a rate of 200Hz and can operate at 17 μJ for 5000 hours.

In addition to the OptiBeam™ laser, the AB SCIEX TOF/TOF™ 5800 System also has variable rate 1kHz laser for faster data acquisition. The laser can operate at 30 μJ and has a lifetime of about 10000 hours. In addition, the 5800 system has a self-cleaning MALDI source for increased instrument up-time.

Conclusions

- Several authors have observed that the desorbed material in MALDI mass spectrometry shows a distribution which is directed back towards the direction of the incident laser 2,3,4,5,6.
- By adjustment of the incident laser, the optimum sensitivity was found with the on-axis laser irradiation as found in the OptiBeam™ Laser.
- Lower levels of matrix contamination on ion optical devices are observed with on-axis laser irradiation in comparison to other laser angles.
- The AB SCIEX TOF/TOF™ 5800 System and the 4800 MALDI TOF/TOF™ Analyzer achieve high sensitivity in MS and MS/MS modes due to OptiBeam™ On-Axis Laser Irradiation

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