Matrix Assisted Laser Desorption Ionization – Time of Flight (MALDI-TOF)

Ultraflex I
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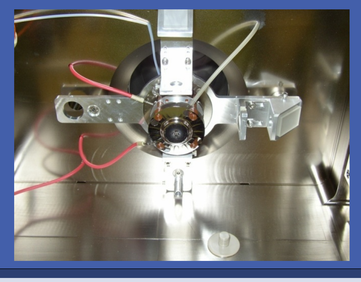
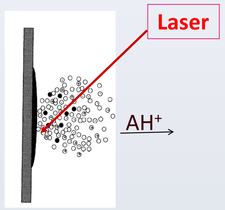


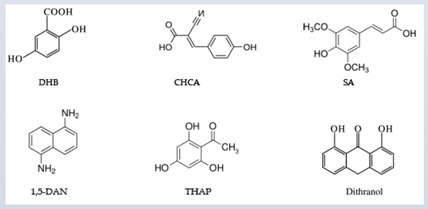
Matrix Assisted Laser Desorption Ionization (MALDI)



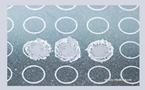
1. Either sample (A) is mixed with excess matrix (M) and dried on a MALDI plate or solutions of M and A are placed on the plate sequentially.
2. Laser flash ionizes matrix molecules.
3. Sample molecules are ionized by proton transfer from matrix:

   $MH^+ + A \rightarrow M + AH^+$.

Common MALDI matrices



MALDI Targets



2,5-dihydroxy benzoic acid crystallized on stainless steel target

2,5-dihydroxy benzoic acid crystallized on AnchorChip target

During solvent evaporation, sample shrinks onto the hydrophilic anchors (200-800 µm) in hydrophobic surroundings.
Enhance sensitivity by a factor of 10-100.

Time of Flight (TOF)

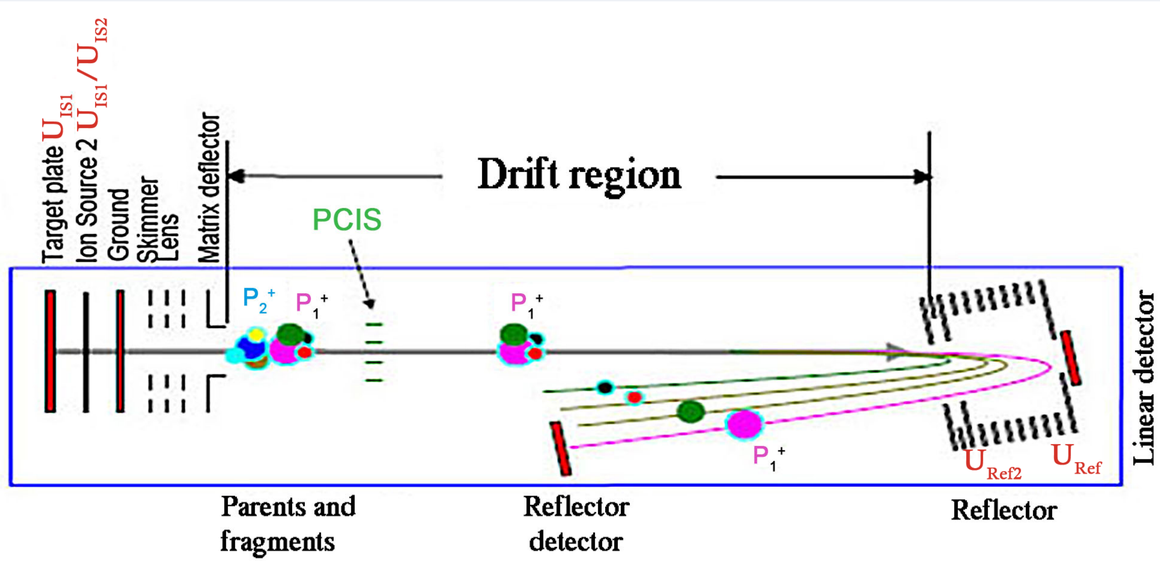
$$\frac{m}{z} = \frac{2t^2U}{L^2}$$

t = drift time, L = drift length
m = mass,
U = acceleration voltage
z = number of charges on ion

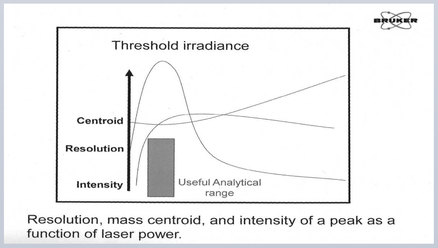
If U = 20 KV, L=1.8m, m = 1000 Da, z= +1

$$t = \frac{1.8\text{m}}{\sqrt{2 \times 20000\text{V}}}\sqrt{\frac{1000\text{Da} \times 1.660539 \times 10^{-27}\ \text{kg Da}^{-1}}{1.602 \times 10^{-19}\ \text{C}}} = 2.9 \times 10^{-5}\text{s}$$

Instrument Schematics and tuning

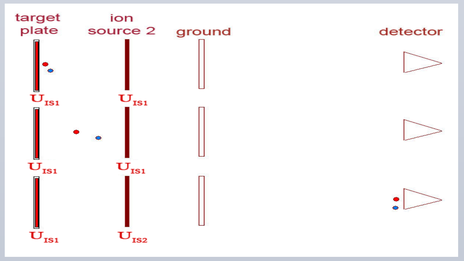


U_{IS1} (~20-25 KV) & U_{IS2} (~85-95% of U_{IS1}), acceleration voltages applied on Ion Source 1 and Ion Source 2 plates
U_{ref} (~21-26.5 KV) & U_{ref2} (~50-60% of U_{ref}) reflector and reflector 2 voltages
PCIS, Precursor Ion Selector; P_1^+ and P_2^+, precursor ions
Flight tube length: linear, 182cm; reflectron, 320 cm
Laser: MNL 100 N_2 laser, LTB Lasertechnik Berlin,
337nm, 150µJ/3ns, beam dimension, 3 x 4 mm, focused spot size, ~0.1 mm

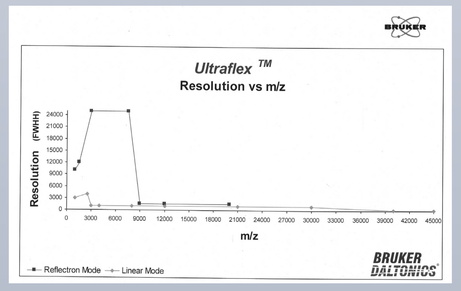


Resolution, mass centroid, and intensity of a peak as a function of laser power.

Laser Power



Pulsed Ion Extraction (PIE) delay



Linear or reflectron analyzer

Two Stage Ion Reflector

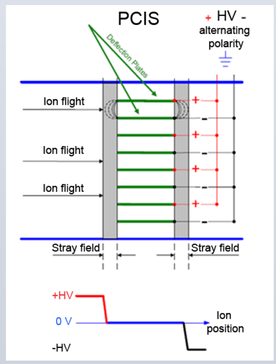
Ions with same m/z but higher kinetic energy penetrate deeper into reflector electrostatic field, delaying their arrival time at the reflector detector , which results in improved resolution.

Focus in time and space about 30% of difference in kinetic energy. Two stages minimize chemical noise.

Tandem MS

	Post Source Decay (PSD)	In Source Decay(ISD)
Fragmentation location	After source	Inside source
Precursor ion selection	yes	No
Precursor ion mass	<4 KDa	1-100 KDa

Post Source Decay (PSD)

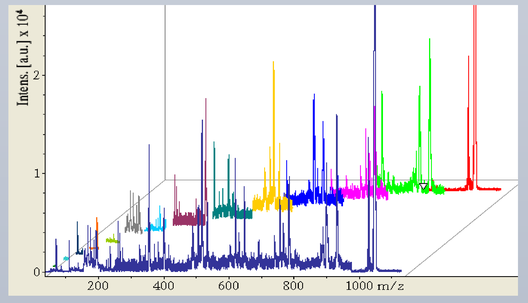


Precursor Ion Selector (PCIS)

Electrostatic field perpendicular to the ion flight path deflects ions.

5-10 Da window

In FAST (Fragmentation Analysis and Structural TOF) method reflector voltage is reduced stepwise to guide fragments to the reflector detector.



Fragments and combined PSD spectra of Angiotensin II peptide