Atmospheric pressure MALDI imaging Orbitrap MS using a Masstech AP/MALDI UHR ion source

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY | LIST

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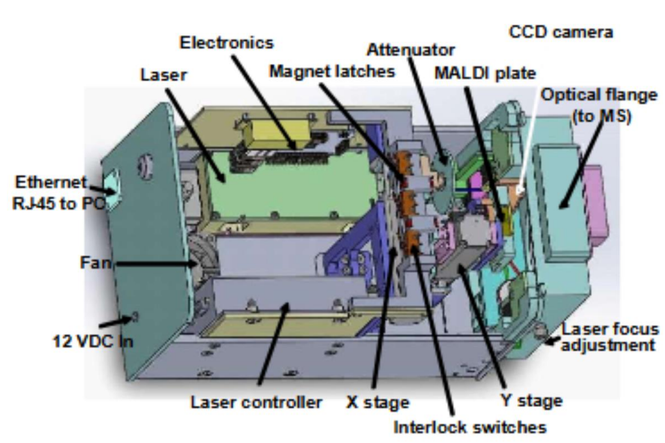
Introduction: *The interest of scientist for MALDI imaging is growing since the last decade and latest developments have led to a significant impact in the pharmaceutical and cosmetics field, but also in materials research. MALDI imaging is now enabled on high resolution Orbitrap instruments by means of Atmospheric Pressure MALDI sources available on the market*

Methods

An **AP-MALDI UHR** ion source (Masstech Inc.) coupled to a **LTQ/Orbitrap Elite** high resolution mass spectrometer (Thermo Scientific) was used for the development of targeted and untargeted imaging Mass Spectrometry experiments.
Samples were coated with matrices using a HTX-TM sprayer.

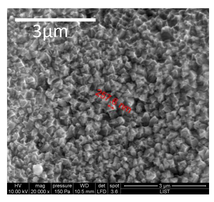
The Masstech AP/MALDI UHR ionization source contains all electronics, x,y controllers, laser optics in a compact design. This module replaces the Thermo IonMAX ESI/APCI source within a few minutes.



MassTech

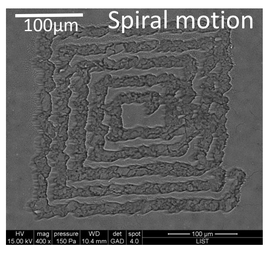
Matrix deposition using HTX TM-Sprayer

→ Sub-micron HCCA crystals deposited on a mouse brain tissue cryo-section, inspected by Scanning Electron Microscopy.



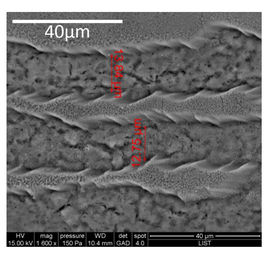
Modes of operation of the UHR AP-MALDI LTQ/Orbitrap setup

UHR AP/MALDI modes for MS analyses:

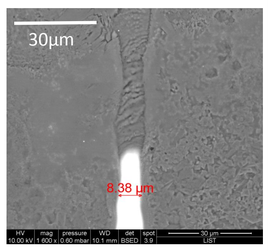


→ Laser ablation following a Spiral motion in HCCA matrix inspected by Scanning Electron Microscopy

→ Tunable focus (8-35µm)

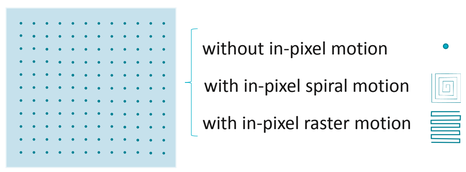


→ Tunable Spiral motion or Raster motion

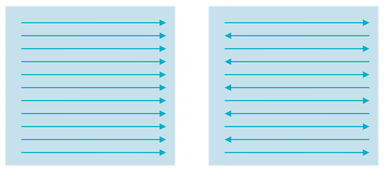


UHR AP/MALDI modes for MS imaging:

Pixel map:

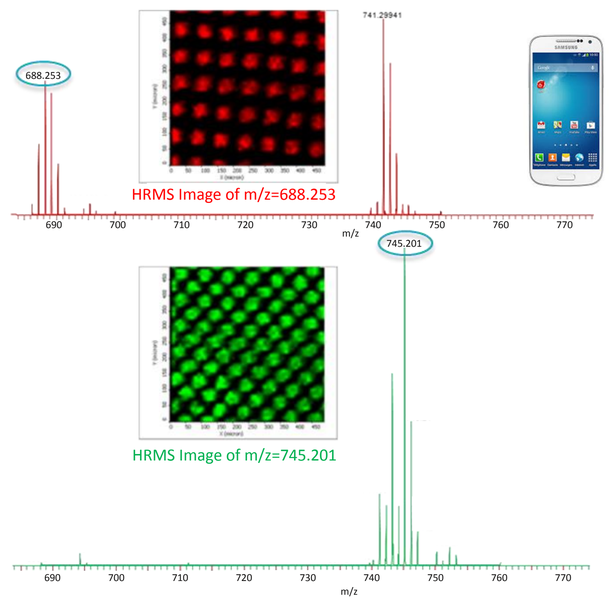


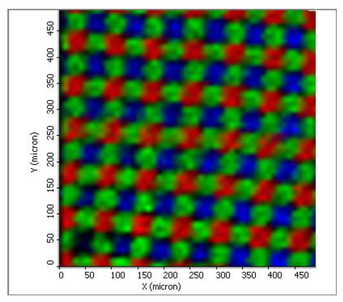
Constant speed raster (CSR)



→ AP/MALDI source parameters can be adjusted to various sample dimensions, pixel density, and MS scan rates.

Untargeted HRMS imaging - OLED display

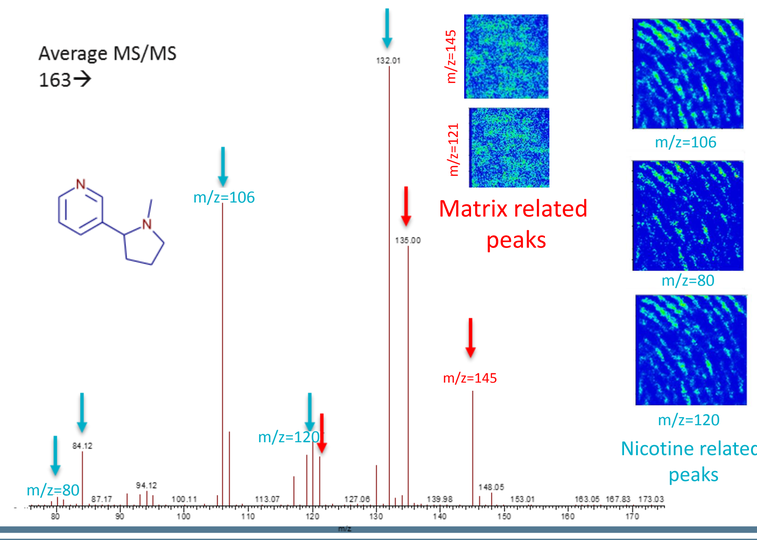




50 x 50 pixels,
Field of View 500x500um

Untargeted imaging using HRMS (full scan) allows to screen unknown molecules in high resolution imaging experiments

Targeted MSMS imaging – Nicotine in fingerprints

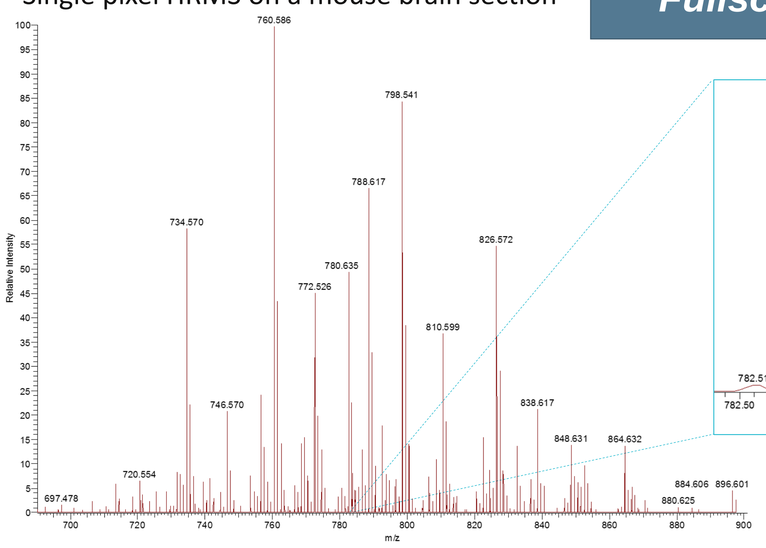


Targeted imaging using MS/MS allows to screen known molecules in high resolution imaging experiments

→ 5 mm x 5 mm surface (+/- 45 minutes) at low mass resolution in the LTQ

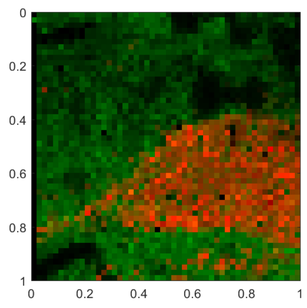
Fullscan HRMS (Orbitrap) with several simultaneous MS/MS (LTQ) images

Single pixel HRMS on a mouse brain section

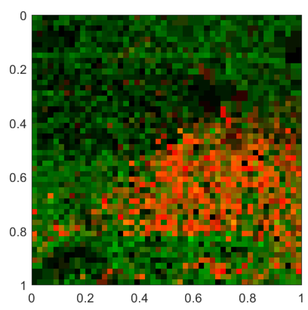


Px size 20 µm
Field of View 1mm²

HRMS Full scan + MS/MS images



782.650 = [GlcCer(d40:2)+H]+
782.567 = [PC(34:1)+Na]+



m/z=782.6
→602.6 (loss of Glc)
→ 723.5 (loss of choline)

→ Multiple scan events can be adjusted in each pixel to provide Full scan and several MS/MS or SRM images from the same acquisition

→ MS/MS or SRM images provide structural confirmation for the unambiguous localization of molecules of interest in AP/MALDI imaging

Conclusions

- *We show the characteristics and applications of a Masstech AP-MALDI UHR ion source to enable targeted and untargeted MALDI imaging capabilities down to 10 micron lateral resolution, when associated to a LTQ/Orbitrap mass spectrometer. This system allows to rapidly switch from the MALDI configuration to LCMS configuration.*
- *AP-MALDI (Masstech UHR ion source) HR-MS or -MSn imaging capabilities down to 10 micron lateral resolution are demonstrated.*

See poster WP-126 on Skin imaging by Mass spectrometry, D. El Assad on Wednesday

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