



Infrared Laser Desorption Ionization Mass Spectrometry Imaging

Introduction

In UV MALDI mass spectrometry imaging (MSI), samples such as tissue cross sections are covered by the matrix and the sample is moved in 2D while irradiated by a UV laser to create a spatially resolved biomolecular mass image map. Matrix deposition process is time consuming, requires complicated and expensive dispensers and can displace sample constituents. In addition, the manner in which the matrix crystal forms can limit the resolution of the image. In this application note, IR LDI MSI is used to construct an image without matrix addition.

Experimental conditions

The letters O-P-O were written on a Si target with three Sharpie® ultra fine point marker colors: orange for the first O, blue for the P and purple for the second O. The Si target was inserted into a custom-built time-of-flight mass spectrometer and desorbed and ionized at 2.95 μm using an IR Opolette running at 20 Hz. A LabView VI was made to control moving the Si target mounted on an X-Y stage using a predetermined pattern and image resolution (based on laser spot size). MathLab was used to construct the image from recorded mass spectra.

Results

A digital image of the sample taken after laser irradiation is displayed in Figure 1a. Scanned rows can be seen with circular laser ablation craters side by side. A 50x26 pixel image with 200 μm resolution was successfully taken using the base peak of the mass spectra from each color marker. The mass spectra from each color marker are shown in Figure 1c,d,e. The base peak is assumed to be signal from ionization of dye molecules in the marker. The spectra are mostly clear of chemical noise in the low mass region since no matrix is added.

Conclusions

A demonstration of IR LDI MSI was successfully performed using a mid-IR tunable OPO. Ionization of dye molecules from the ink deposit were used to construct a molecular image map with a 200 μm resolution. Future work will focus on increasing resolution and moving to the high repetition rate IR Opolette HR laser system to decrease data acquisition time.

Acknowledgements

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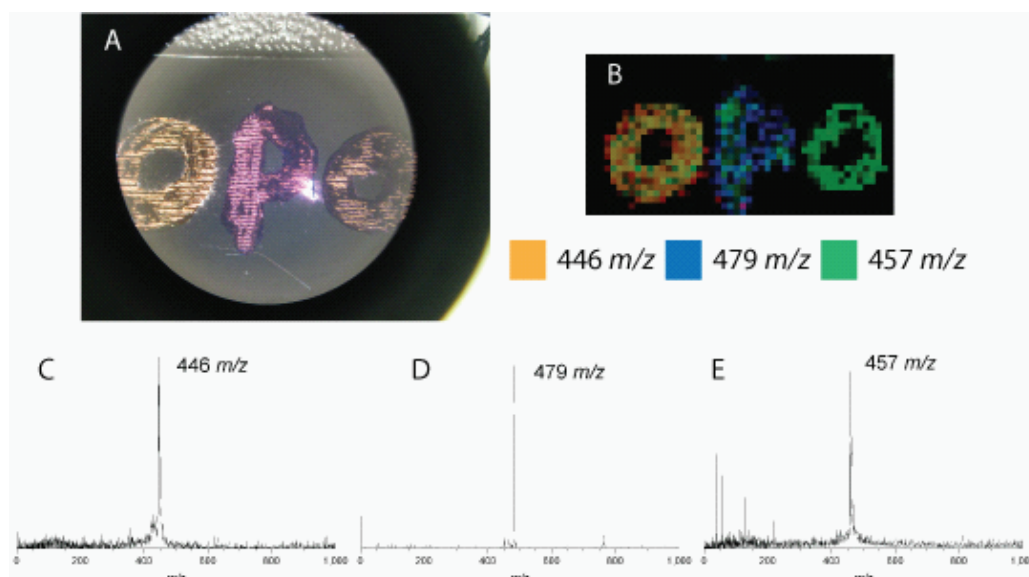


Figure 1. A) Post MSI 2x mag digital image of letters OPO written with three different color markers. Scanned rows can be seen with circular laser irradiation spots. B) 50 x 26 pixel MSI scan, $\lambda = 2.95 \mu\text{m}$, 200 μm resolution, three m/z peaks selected, one from each color marker: C) Orange Marker mass spectrum D) Blue marker mass spectrum E) Purple marker mass spectrum.