Applications Note

SpiralTOF™

High Mass Resolution MALDI-Imaging MS

High Stability of Peak Position during Imaging MS Measurement

Introduction

Matrix-assisted laser desorption/ionization imaging mass spectrometry (MALDI-Imaging MS) is a powerful tool for the biochemical analyses of surfaces. Previously, this technique has been used to determine the spatial distribution of hundreds of unknown compounds in thinly sliced tissue sections. The mass spectral images are generated by changing the laser irradiation point at regular intervals across the sample surface and collecting a mass spectrum for each point. Time-of-flight mass spectrometers (TOFMS) are widely used as the mass analyzer for MALDI-Imaging MS because they are well matched for the MALDI ionization process. However, the fine structure of the matrix crystals and small irregularities in the tissue surface flatness can cause peak drift in the collected mass spectra that is caused by slight differences in the starting point of the flight path for the ions at each laser irradiation point. As a result, the typical reflectron type TOFMS systems have a difficult time achieving high mass resolution from spot to spot over a thinly sliced biological surface. Conversely, the JEOL JMS-S3000 "SpiralTOF™", which has 5-10 times longer flight path than the reflectron type TOF, is able to reduce the effect of this mass drift to achieve high mass resolution and high mass accuracy.

In this work, we report the advantages of using the SpiralTOF for MALDI-Imaging MS analyses of lipids in a mouse brain tissue section.

Experimental

A mouse brain tissue section was placed on an ITO conductive glass slide plate. The matrix compound DHB was sprayed onto the surface of the tissue and then the sample was introduced into the mass spectrometer. The Imaging MS measurements were performed on the left half of the brain tissue section (5 mm×7 mm) with 40 µm spatial resolution.

Results and Discussion

The averaged mass spectrum of all image pixels is shown in Fig. 1. The base peak ion *m/z* 798 was estimated as Phosphatidylcholine (PC) (34:1) [M+K]+. The mass image of *m/z* 798 with ±0.1 u mass window is also shown in Fig.1. This image shows that the PC (34:1) is distributed uniformly throughout the brain tissue section. The four regions-of-interest (ROI) 1 – 4 were selected from the top, right, bottom and left in the measured area, respectively. The peaks for the PC (34:1) [M+K]+ from the accumulated mass spectra for ROI 1 – 4 are shown in Fig. 2. These results show that the mass drift was reasonably small dur-

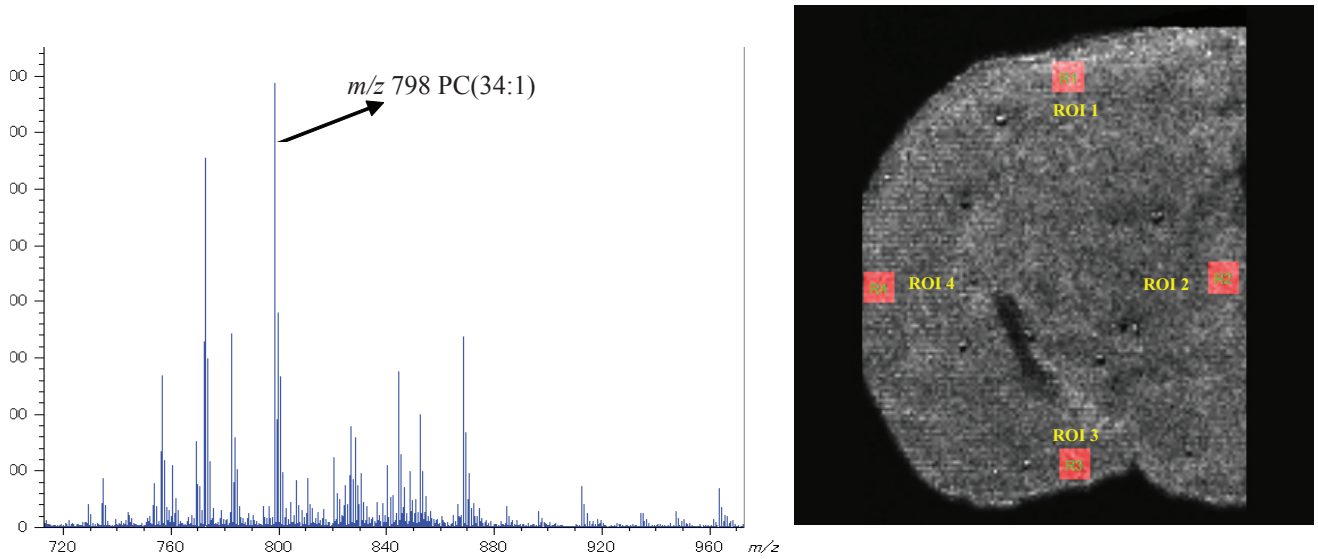

Figure 1. Averaged mass spectrum and mass image of m/z 798

ing their measurements.

It is important to note that for the mass analysis of lipids in mouse brain tissue, various types of lipid ions are observed as doublet or triplet peaks in the mass spectrum. For example, the mass spectra of ROI 1 – 4 at *m/z* 822 - 823 are shown in Fig. 3. The mass differences for these peaks were only 0.1 u. As it turns out, commercially available TOF/TOF instruments have insufficient precursor ion selectivity so it is difficult to determine their structures through MS/MS. Therefore, high mass resolution and high mass accuracy, which result when the measured peak positions are stable during Imaging MS measurements, are necessary for elemental composition estimations. As these results show, the JEOL SpiralTOF provides very good mass stability during MALDI Imaging of tissue. Therefore, the average mass spectrum for the whole image (Fig. 1) can be used to calculate the elemental composition of an unknown compound in the mouse brain tissue surface using a single point calibration [1].

Acknowledgment

This data was acquired in a joint research project with the Graduate School of Science, Osaka University. We thank Mr. N. Moriguchi, Assistant Professor Dr. H. Hazama and Professor Dr. K. Awazu for providing the mouse brain tissue specimens.

Reference

(1) Takaya Satoh et al., ***Mass Spectrometry,*** Vol. 1 (2012), A0013

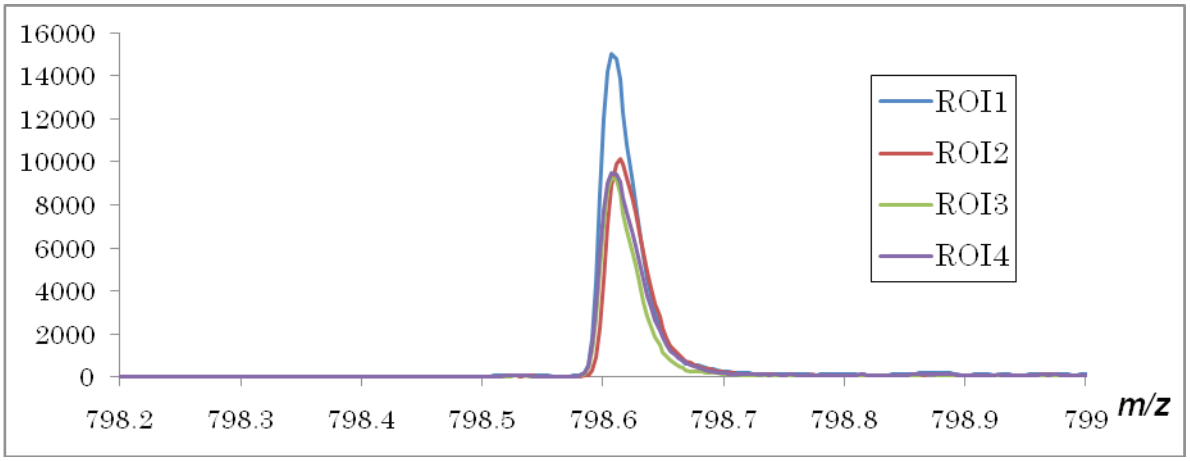

Figure 2. Mass spectra of ROI 1 – 4 at m/z 798

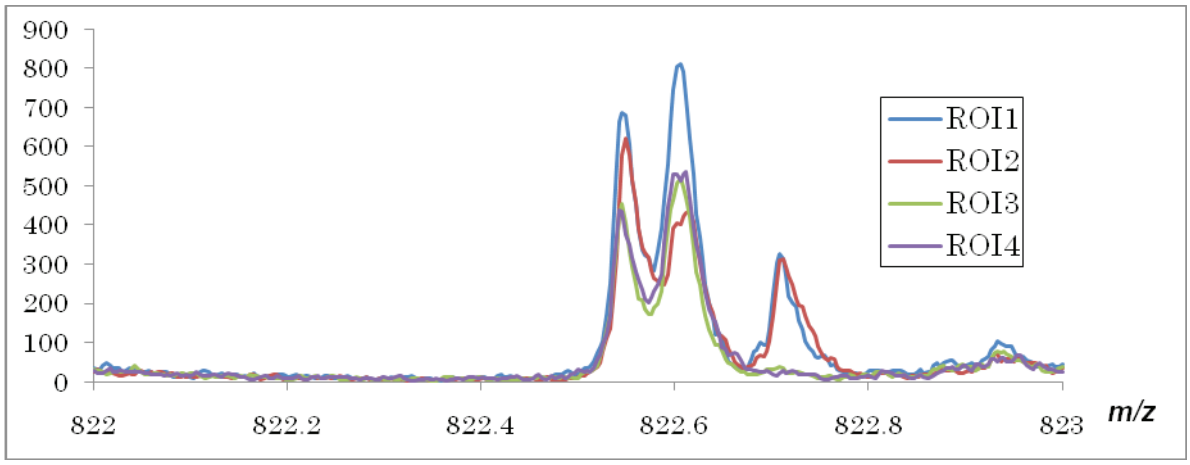

Figure 3. Mass spectra of ROI 1 – 4 at m/z 822