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Application News

iMScope QT Imaging Mass Microscope

Wide-area, Fast, and High-definition MS Imaging of Mouse Brain Using iMScope QT

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User Benefits

- The maximum measurable area of iMScope QT exceeds 1 mega pixels, allowing for analysis of a large area, such as a whole mouse brain slice in a single run.
- The analysis speed of iMScope QT is more than 8 times faster than that of iMScope *TRIO*, allowing for a rapid analysis.
- The iMScope QT has high mass accuracy (<1 ppm) and high mass resolution (>30000) to obtain accurate masses.

■ Introduction

In MS imaging, biomolecules and metabolites are measured directly by a mass spectrometer while maintaining the positional information on the sample tissue in order to produce a two-dimensional distribution map of various biomolecules using the obtained signal intensity of specific ions in the mass spectrum and the positional information. The iMScope mass microscope is the hybrid type of instrument that specializes in this MS imaging, combining an optical microscope and a mass spectrometer, which enables the analysis of structure and distribution of substances, expanding the possibilities of research in all fields including drug discovery and metabolite studies. The iMScope can also be used for LC-MS qualitative and quantitative analysis by switching the MALDI part to an LC and ESI system. In this article, we will introduce the features of the further evolved, new iMScope QT (Fig. 1), equipped with a Q-TOF mass spectrometer, while comparing with the previous model, iMScope *TRIO*.

Fig. 1 iMScope QT

■ Analysis of Whole Mouse Brain Slices

The maximum measurable area of the previous model, iMScope *TRIO*, was 250 × 250 pixels. In iMScope QT, the area has been greatly expanded to 1024 × 1024 pixels, allowing the analysis of a whole mouse brain slice (approx. 17 mm × 9.4 mm) with a spatial resolution of 15 µm. As a result of analysis under the conditions shown in Table 1, we could obtain clear MS images of PI (38:4) at *m/z* 885.557, a type of phosphatidylinositols, and sulfatide (C24:1) at *m/z* 888.631, a type of sulfatides (Fig. 2).

Furthermore, since the maximum repetition frequency of iMScope QT is 20 kHz and thus the analysis speed is more than 8 times faster than that of iMScope *TRIO*, MS imaging of the whole mouse brain slice (702624 pix) shown in Fig. 2 was completed in about 6 hours.

Table 1 Analytical Conditions

Matrix	: 9-Aminoacridine (9-AA)
Measurement pitch (spatial resolution)	: 15 µm for whole brain slices, 5 µm for cerebellum
Ion species	: Negative ions
Measurement range	: 750-950
Sample voltage	: 3.7 [kV]
Detector voltage	: 2.40 [kV]
Number of laser shots	: 50 [shots]
Laser repetition frequency	: 10 [kHz]
Laser beam diameter setting	: 0 (approx. 5 µm)
Laser intensity	: 25.0 for whole brain slices, 15.0 for cerebellum

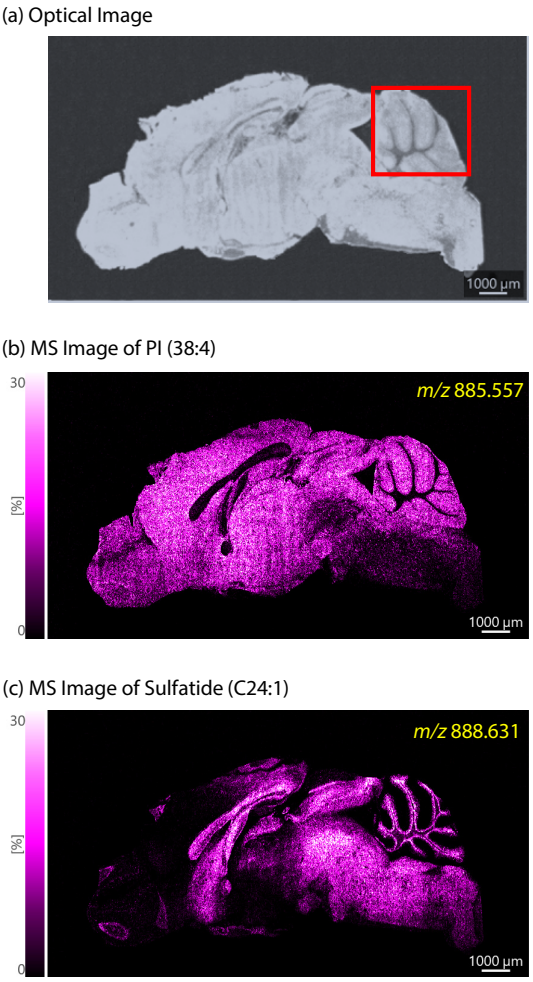

Fig. 2 MS Imaging of the Whole Mouse Brain Slice (Spatial Resolution: 15 µm)

■ High Spatial Resolution Measurements of Mouse Cerebellum

We then performed MS imaging on the area near the mouse cerebellum, indicated by the red rectangle in Fig. 2(a), with a spatial resolution of 5 µm under the analysis conditions shown in Table 1. As a result, we could obtain clearer and more detailed MS images of PI (38:4) at *m/z* 885.557 and sulfatide (C24:1) at *m/z* 888.631 (Figs. 3(b) and (d)).

Moreover, due to high mass accuracy (<1 ppm) and high mass resolution (>30000) of the iMScope QT, it has become possible to separate and detect the PI (38:4) isotope at *m/z* 888.573 and sulfatide (C24:1) at *m/z* 888.631 (Fig. 4), which was not possible with the iMScope *TRIO*, allowing for drawing MS images that specifically show each isotope (Figs. 3(c) and 3(d)).

■ Conclusion

Compared to the iMScope *TRIO*, the iMScope QT has a significantly larger analysis area and faster analysis speed, enabling rapid imaging of a wider region. In addition, the improved mass accuracy and mass resolution have enabled more rigorous and specific MS imaging of a variety of targets.

With these features, the iMScope QT will open up a new era of MS imaging, not only by integrating mass spectrometry and morphology, but also by realizing faster, more sensitive, and higher spatial resolution measurements in a wider range of fields.

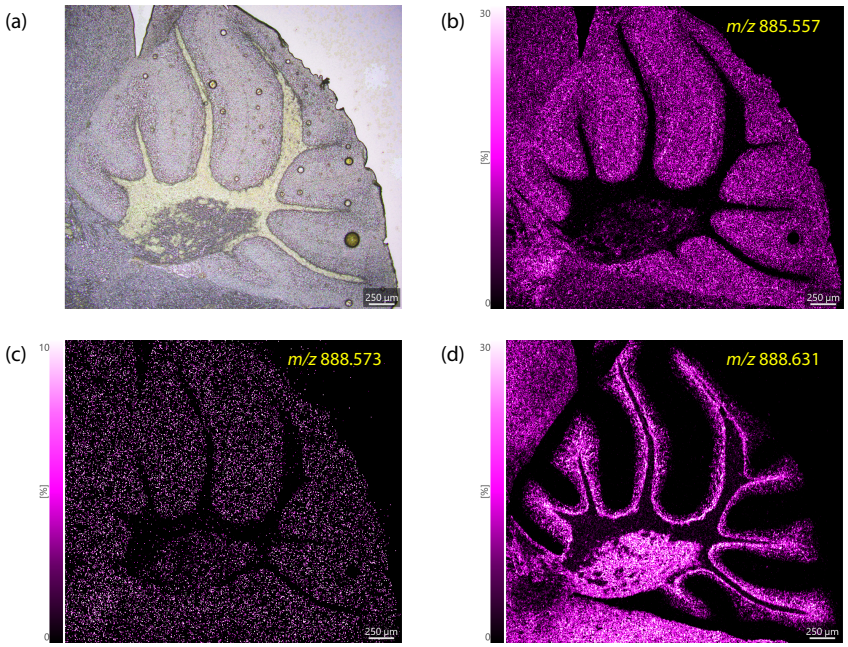

Fig. 3 Optical and MS Images of Mouse Cerebellum (Spatial Resolution: 5 µm)
(a) Microscopic Image
(b) MS Image of PI (38:4) at *m/z* 885.557
(c) MS Image of PI (38:4) Isotope at *m/z* 888.573
(d) MS Image of Sulfatide (C24:1) at *m/z* 888.631

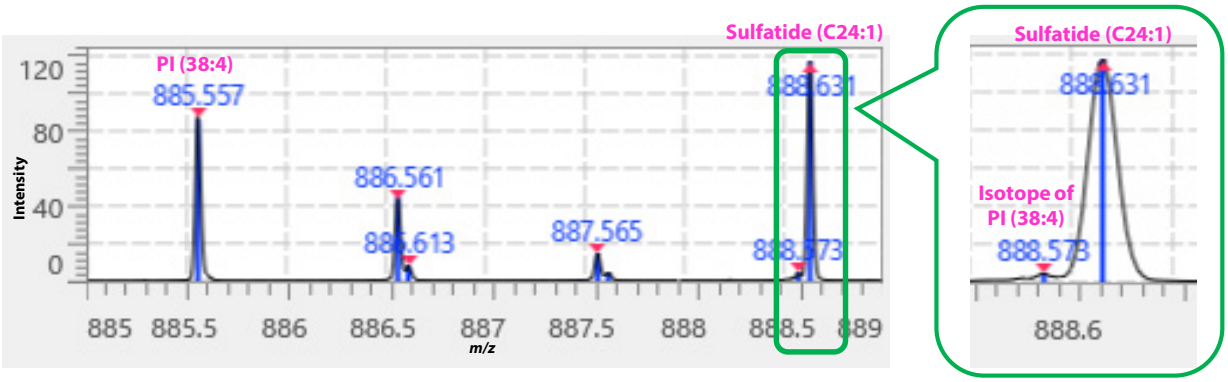

Fig. 4 Enlarged Mass Spectrum near the Peaks Used in MS Images of Mouse Cerebellum

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