Imaging mass spectrometry using JMS-S3000 *"SpiralTOF"*
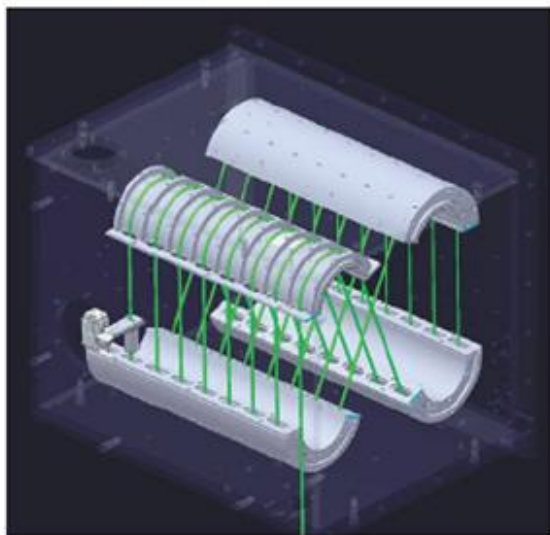
JMS-S3000 "SpiralTOF"
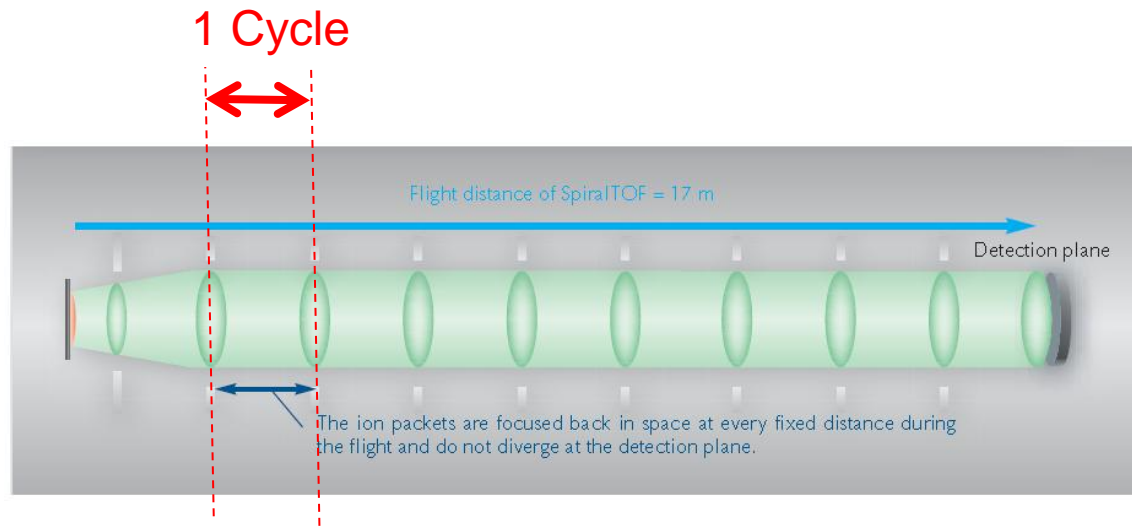
Features of *SpiralTOF*

SpiralTOF is the world's highest mass resolution MALDI-TOFMS adopting JEOL's own ion optical system.

1 Cycle

Flight distance of SpiralTOF = 17 m

Detection plane

The ion packets are focused back in space at every fixed distance during the flight and do not diverge at the detection plane.

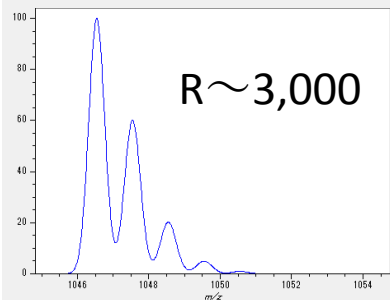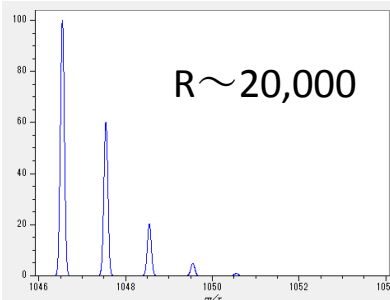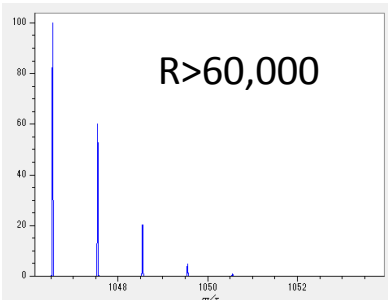*SpiralTOF* achieved 17m flight path, 5-10 times longer than conventional reflectron TOFMS.

Ion packets can be transferred without broadening due to the "perfect focusing".

Features of *SpiralTOF* for Imaging mass spectrometry (IMS)

➤ Ultra-high mass resolution
➤ Low chemical background noise. (Elimination of PSD ions)
➤ High Stability of Peak Position during IMS Measurement

Ultra-high resolution mass spectrometer

|	Peak shape (Angiotensin II)	Mass spectrometer	Features
Low resolution	R〜3,000	Linear TOFMS	High sensitivity High selectivity
High resolution	R〜20,000	Reflectron TOFMS	Accurate mass analysis
Ultra-high resolution	R>60,000	*SpiralTOF* Orbitrap FT-ICR MS	Isobaric peaks separation

Ultra-high mass resolution applied to IMS

IMS using MALDI-MS
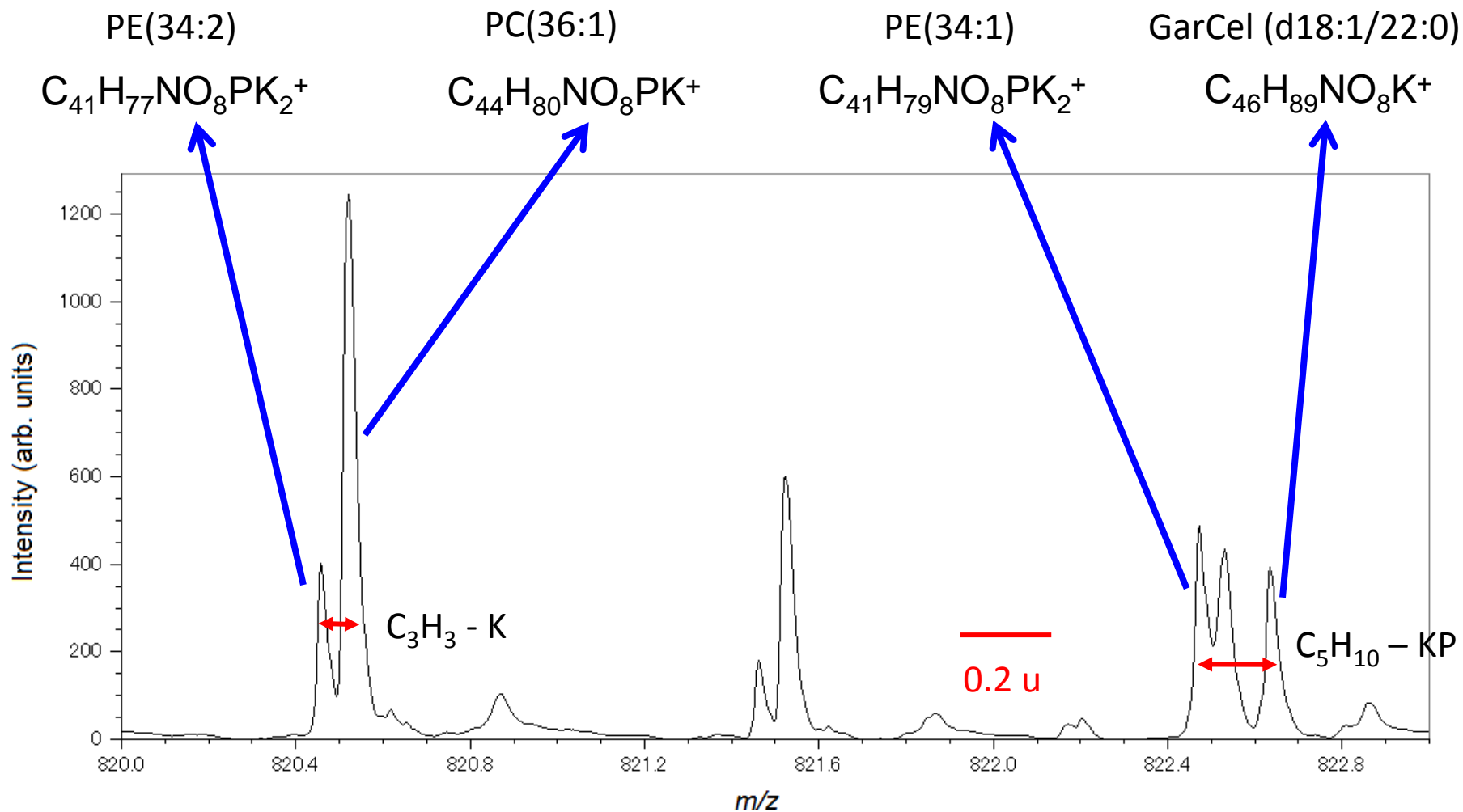

Laser Irradiation

Acquisition points
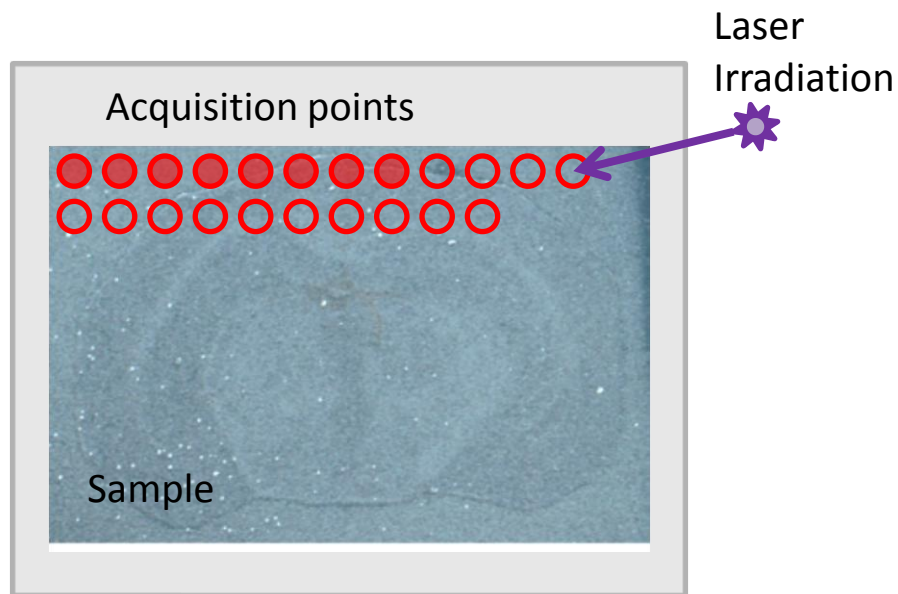
Sample

Conductive target plate on sample stage (X, Y)
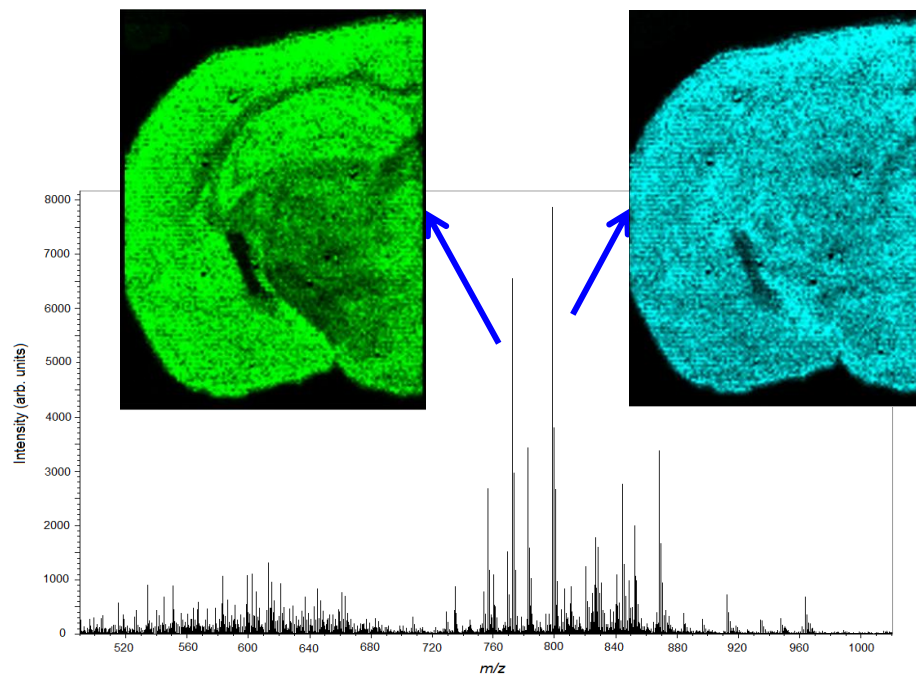
The advantages of the Ultra-high mass resolution MS for
Imaging mass spectrometry are ….
➢ Separation of isobaric compounds in the sample, especially in non-target analysis
➢ Separation from chemical background peaks.

Ultra-high mass resolution mass images

PE(34:2)

$C_{41}H_{77}NO_8PK_2^+$

PC(36:1)

$C_{44}H_{80}NO_8PK^+$

PE(34:1)

$C_{41}H_{79}NO_8PK_2^+$

GarCel (d18:1/22:0)

$C_{46}H_{89}NO_8K^+$

$C_3H_3 - K$

0.2 u

$C_5H_{10} - KP$

PE: phosphatidyl ethanolamine, PC: Phosphatidyl choline, GarCel: galactosylceramide

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Ultra-high mass resolution mass images

PE(34:2)   PC(36:1)   PE(34:1)   GarCel (d18:1/22:0)
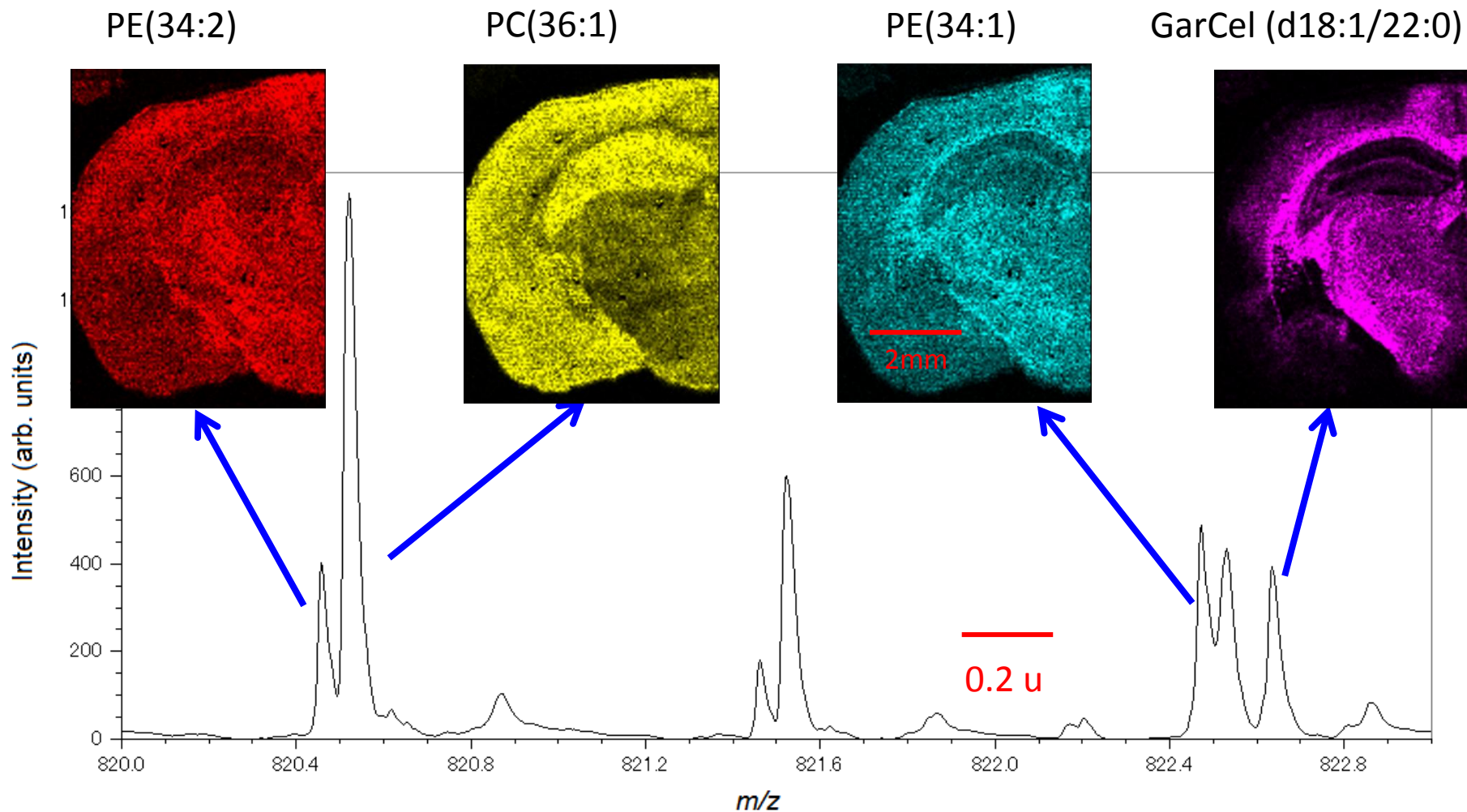
PE: phosphatidyl ethanolamine, PC: Phosphatidyl choline, GarCel: galactosylceramide

High stability of peak position during IMS measurement
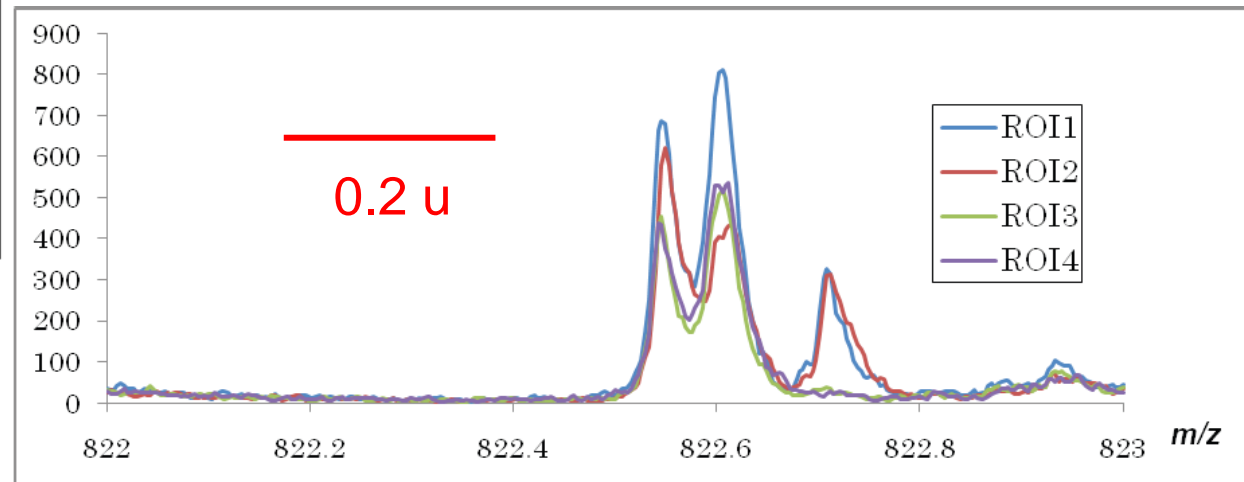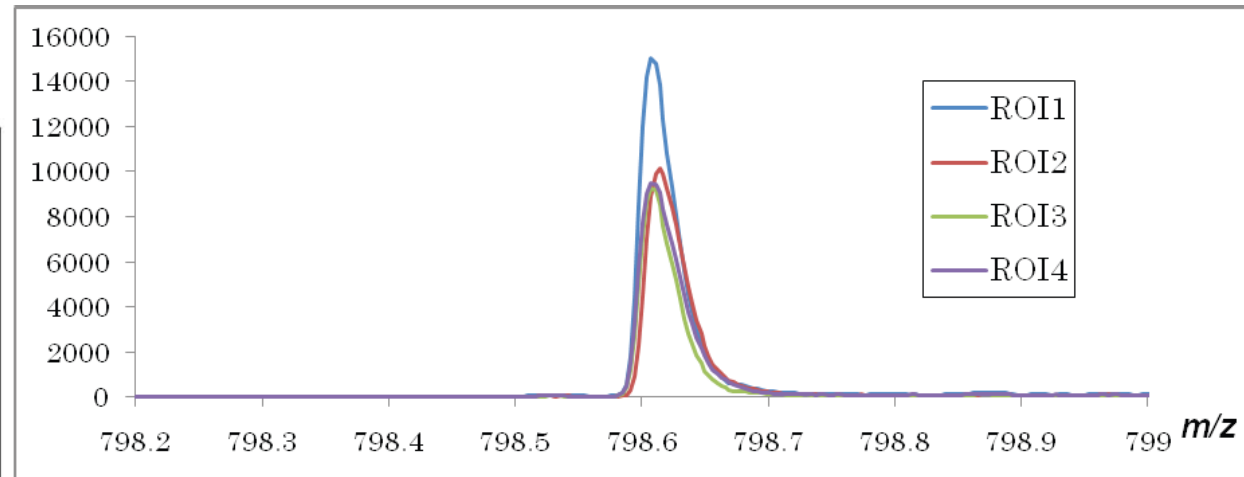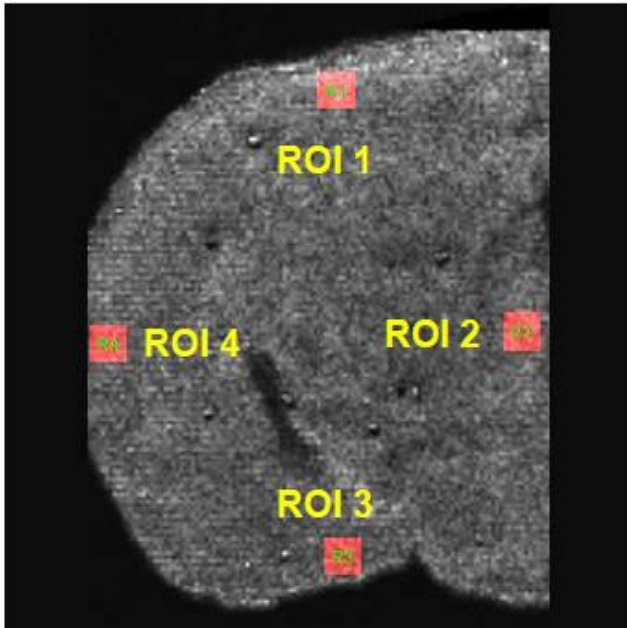
The *SpiralTOF* can reduce peak drift due to fine structure of the matrix crystals and small irregularities in the tissue surface flatness.
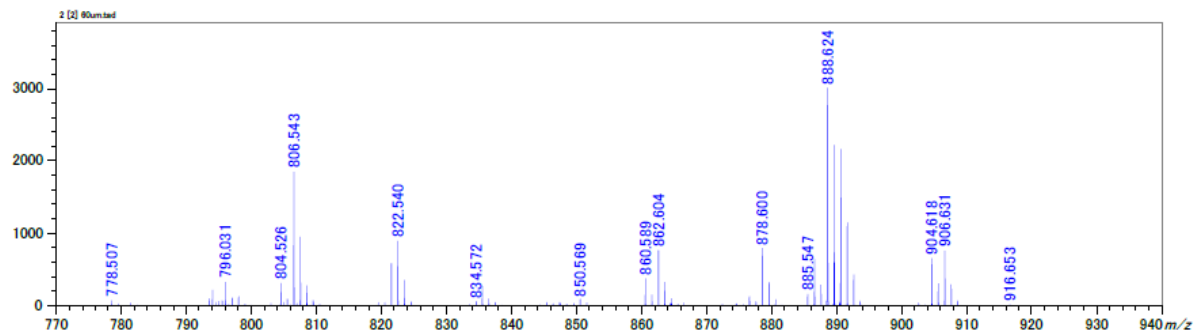
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Application data of IMS using SpiralTOF

Lipids in mouse brain tissue sections (Negative ion mode)

Matrix compound: 9-Aminoacridine

Number	Compound	Formula
1	C16 Sulfatide	$C_{40}H_{76}NO_{11}S$
2	C18 Sulfatide	$C_{42}H_{80}NO_{11}S$
3	C18-OH Sulfatide	$C_{42}H_{80}NO_{12}S$
4	C20 Sulfatide	$C_{44}H_{84}NO_{11}S$
5	C20-OH Sulfatide	$C_{44}H_{84}NO_{12}S$
6	C22 Sulfatide	$C_{46}H_{88}NO_{11}S$
7	C22-OH Sulfatide	$C_{46}H_{88}NO_{12}S$
8	PI(38:4)	$C_{47}H_{82}O_{13}P$
9	C24:1 Sulfatide	$C_{48}H_{90}NO_{11}S$
10	C24:1-OH Sulfatide	$C_{48}H_{90}NO_{12}S$
11	C24-OH Sulfatide	$C_{48}H_{92}NO_{12}S$
12	C26:1 Sufatide	$C_{50}H_{94}NO_{11}S$
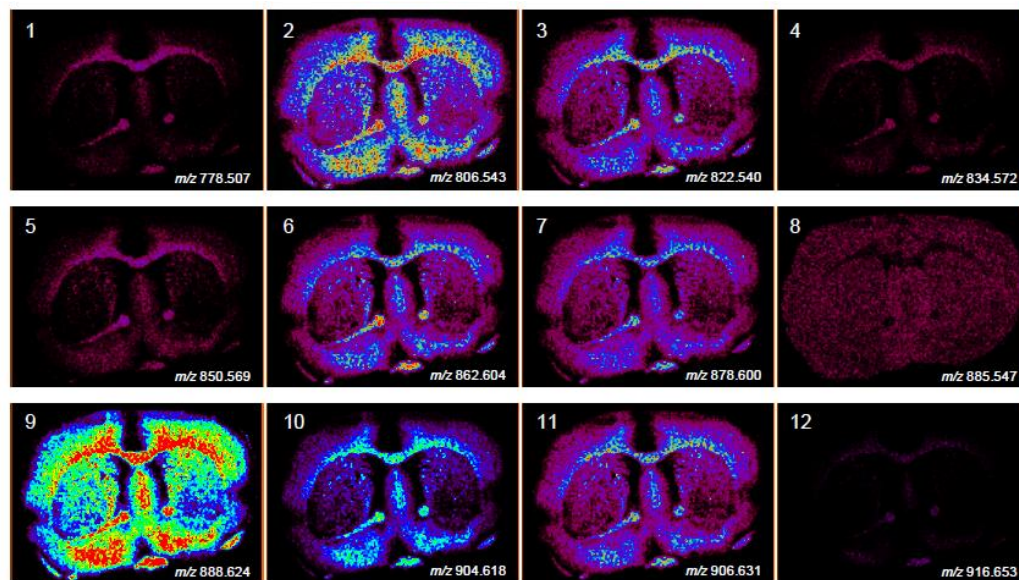
↑ Pixel size: 60 µm

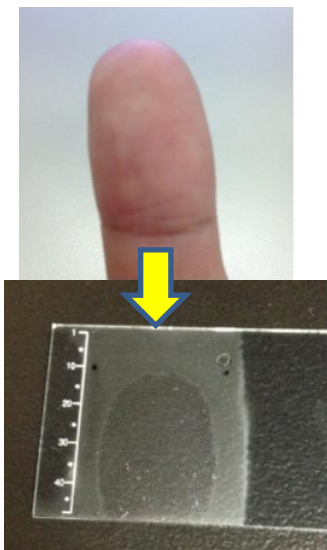# Drug in mouse brain tissue sections

Matrix compound: α-CHCA

Olanzapine

$[M+H]^+$

0.1 u
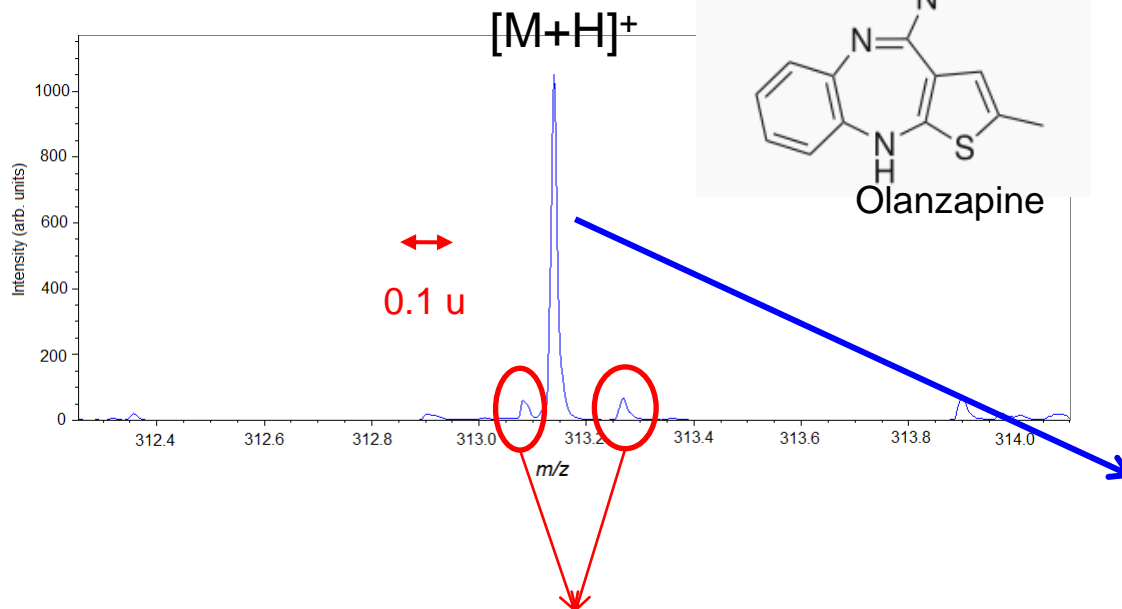
Chemical background peaks

Pixel size: 40 μm→

2 mm

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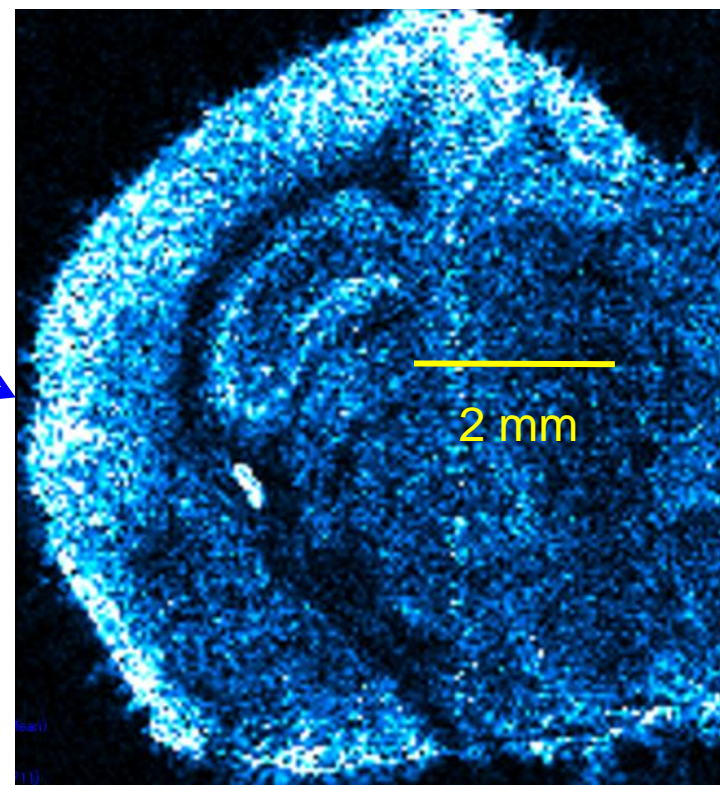
Fingerprint analysis (detection of nicotine from smoker's fingerprint)
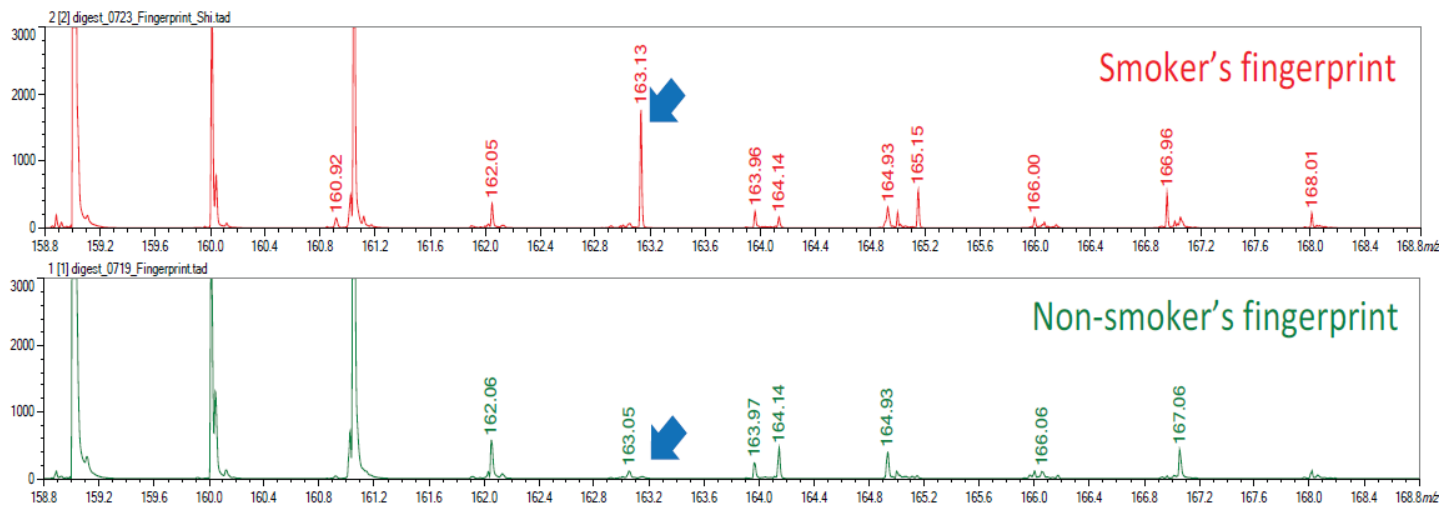
Nicotine, $[M+H]^+ = 163.12297$

$C_{10}H_{14}N_2$
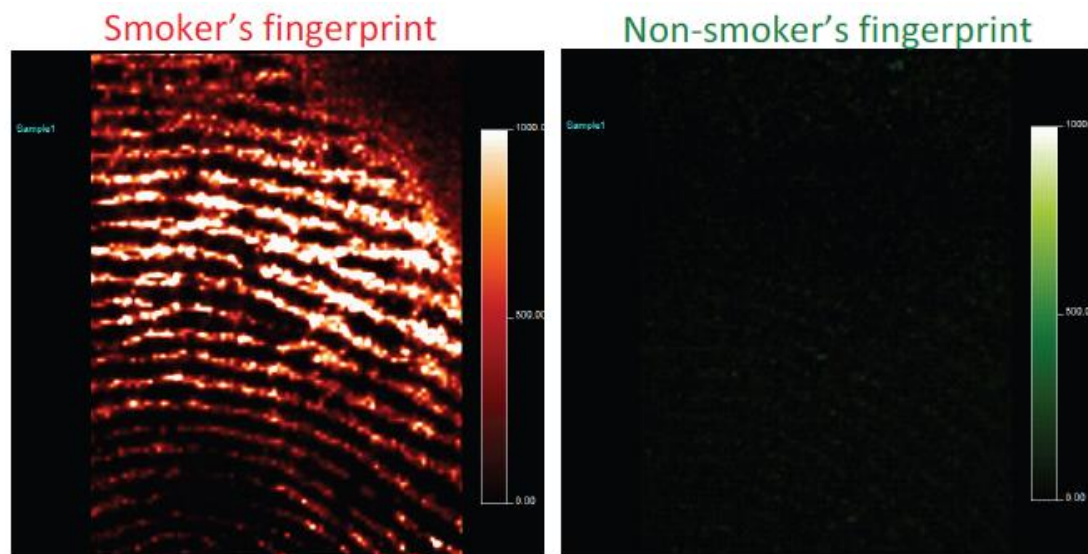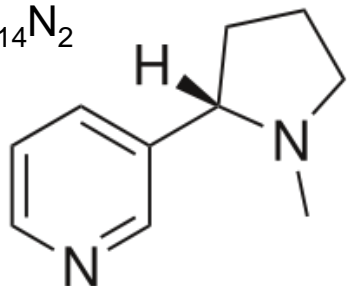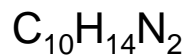
Defect analysis of OLED panel
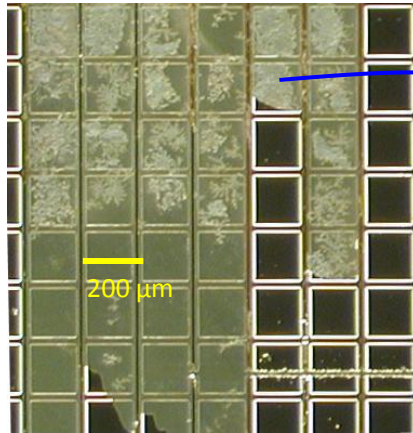
Degradation area

Optical microscope image
(anode pealed)
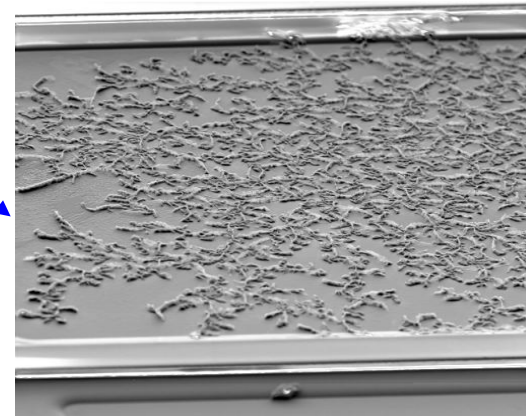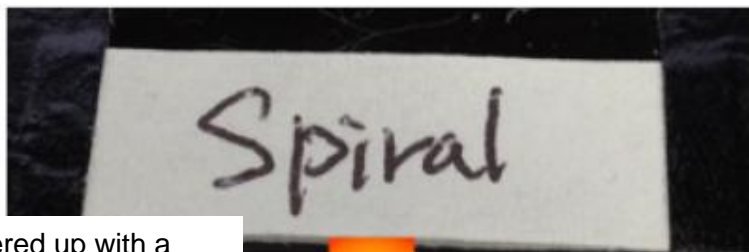
SEM image of degradation area
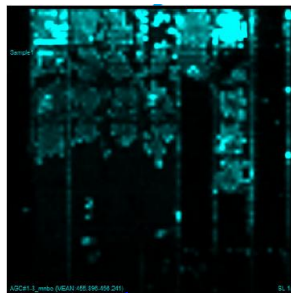
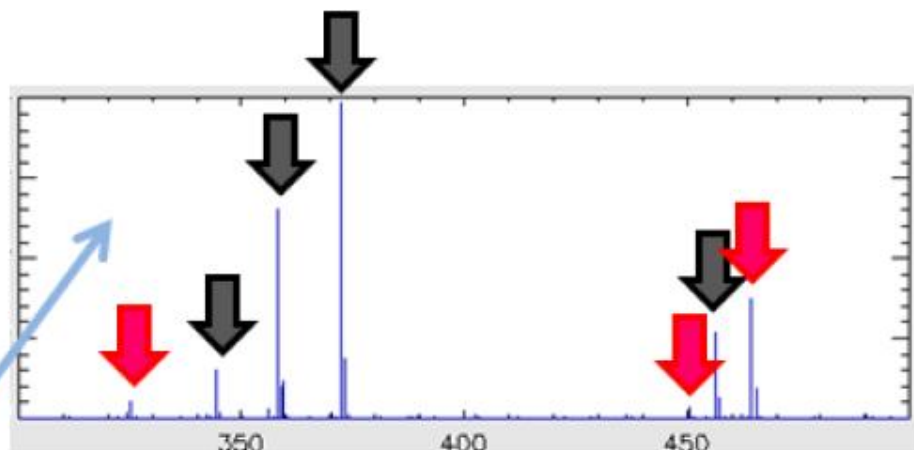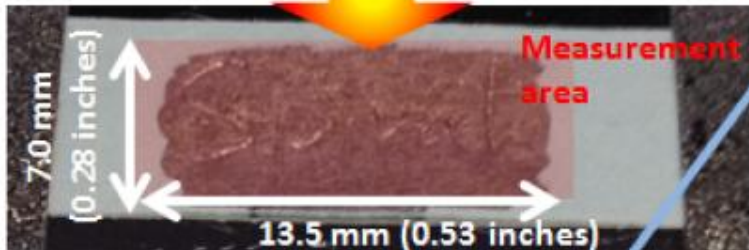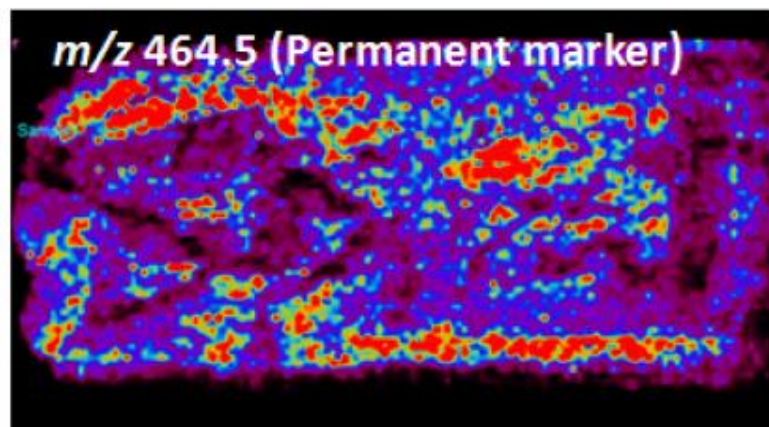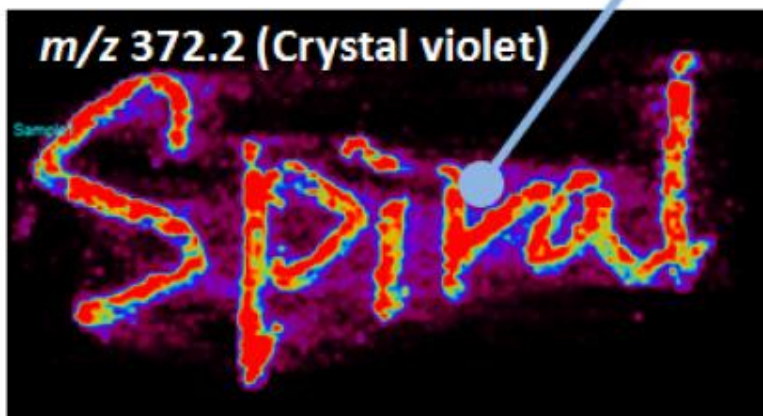A characteristic peak at *m/z* 456 was observed in the degradation area.

Pixel size: 20 μm

α-NPD
Major components in OLED.
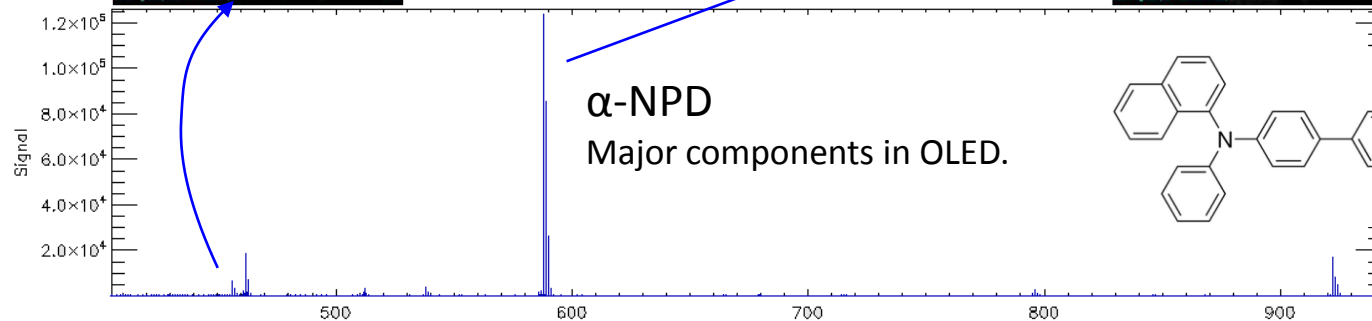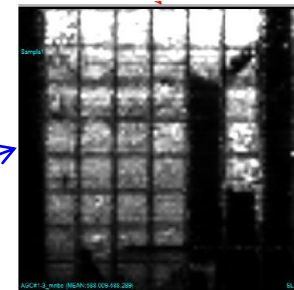
Ballpoint Ink covered up with permanent marker

Covered up with a permanent marker ink

Measurement area

7.0 mm (0.28 inches)

13.5 mm (0.53 inches)

⬇ **Ballpoint pen**   ⬇ **Permanent marker**

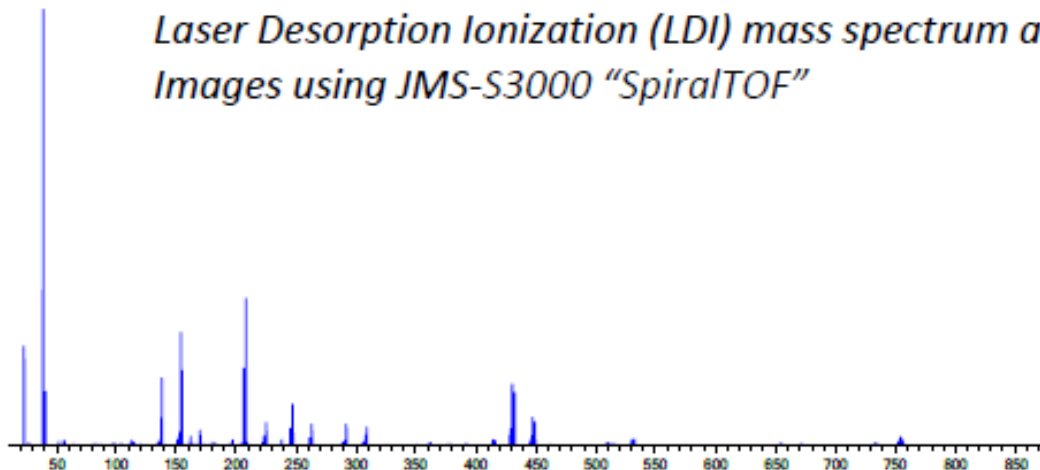*m/z* 372.2 (Crystal violet)

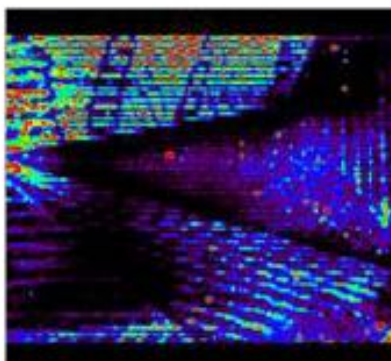*m/z* 464.5 (Permanent marker)

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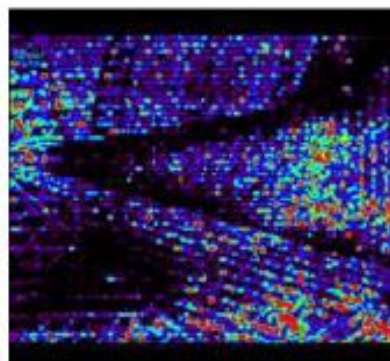
"Gold Star Mothers Stamp"

Laser Desorption Ionization (LDI) mass spectrum and LDI Images using JMS-S3000 "SpiralTOF"

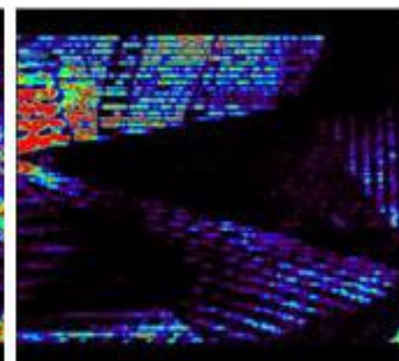**Na Distribution**   **Ba Distribution**   **Pb$_3$CrO$_5$ Distribution**

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Acknowledgment

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