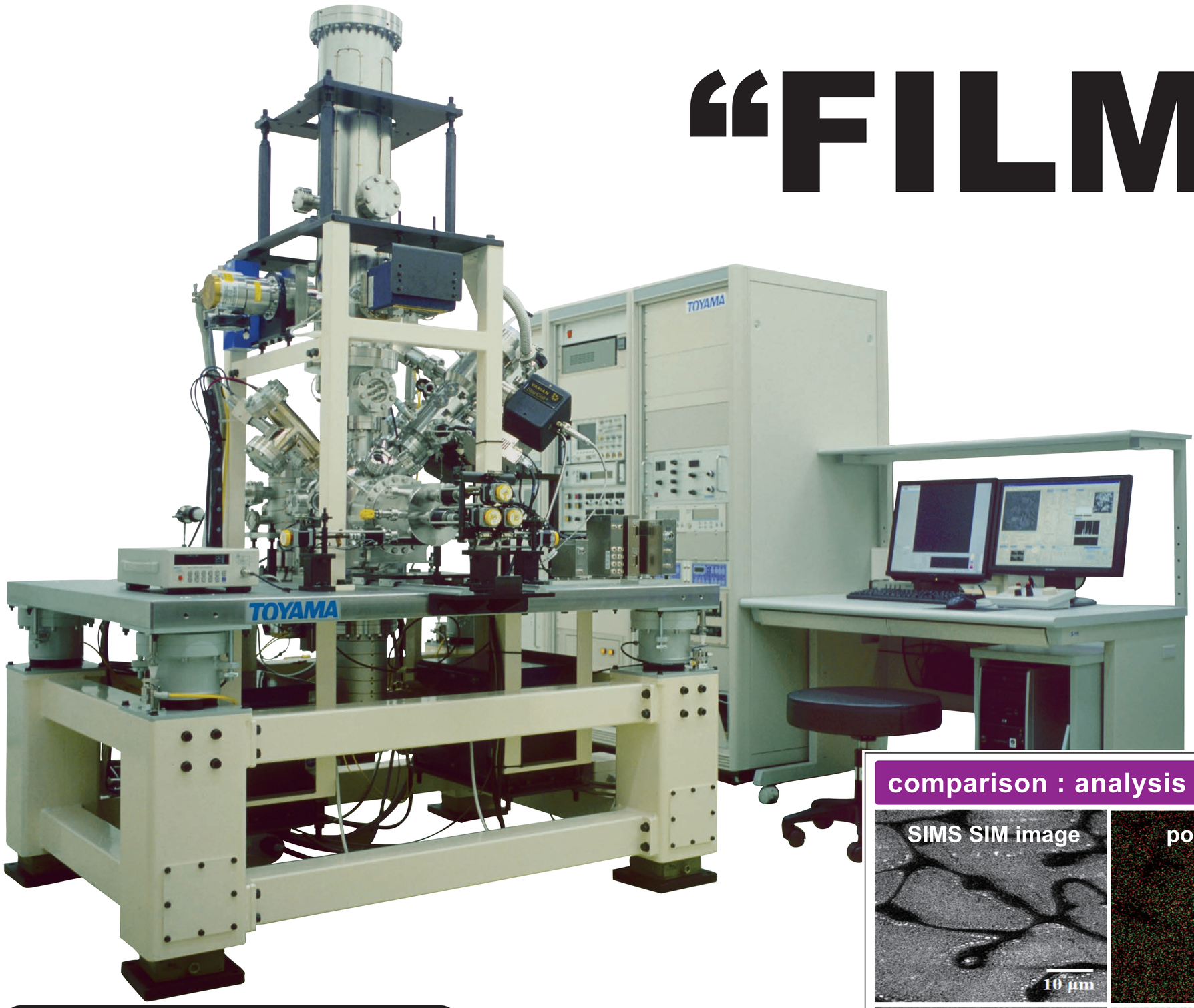
Pioneering New Horizons in Science

TOYAMA

FIB Laser Ionized nano Mass Imager

“FILMER”



Key Features:

1. High Spatial resolution using the optimized Ga-FIB

- lateral resolution < 40nm
- mass resolution m/Δm > 7000@m/z=56

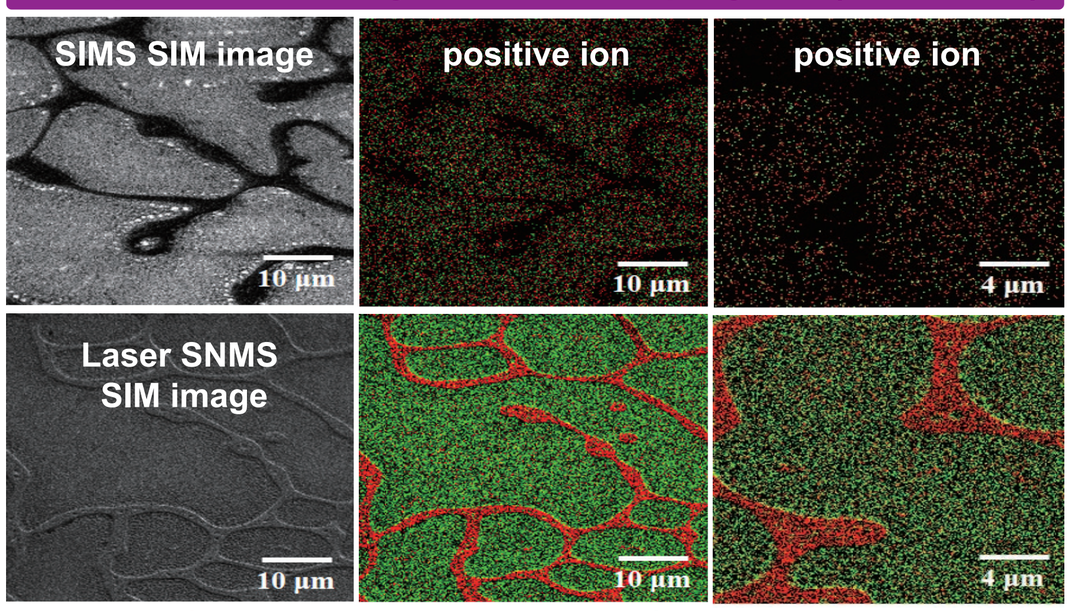
2. Machining and Analysis are available in-situ without air exposure

- little damage observation by SEM directed at the same position as FIB
- possible to analyze both the surface and cross section of a particle

3. Laser SNMS is available

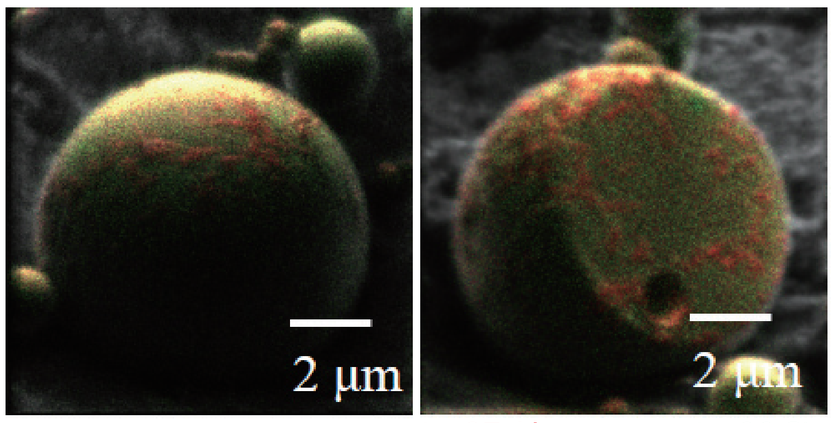
- significant improvement of the signal sensitivity compared to the conventional SIMS
- high sensitive analysis for organic compound

comparison : analysis of blend polymer(PS & PHS)



red:m/z=104 polystyrene green:m/z=120 poly hydrostyrene

coal fly ash：surface & cross section



red:m/z=27 Al green:m/z=28 Si

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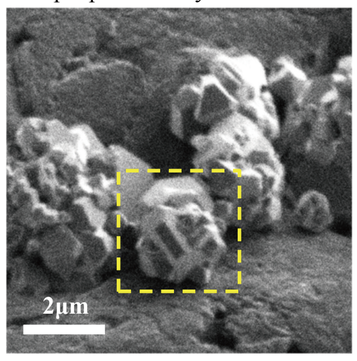
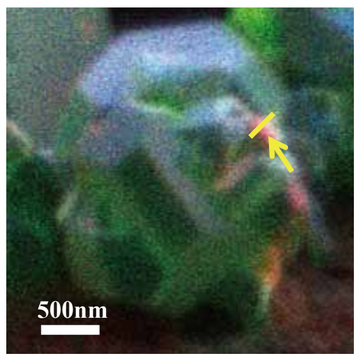
Compatibility between High Lateral Resolution and Mass Resolution

Li Ion Battery(positive electrode)

*Sample provided by AIST



SE Image

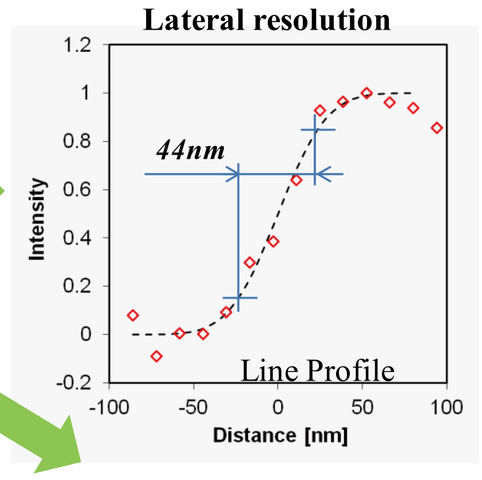


Red: K^+, Green: Li^+, Blue: Mn^+

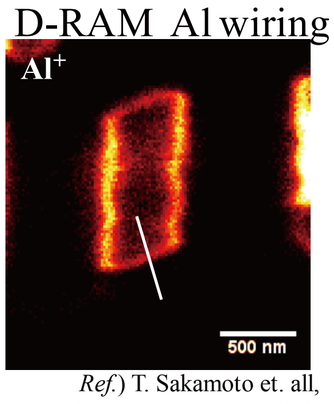
SIMS Image

*FIB current : 60pA

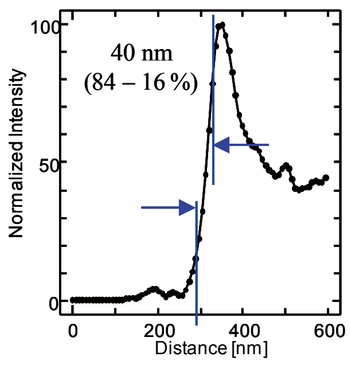
Measurement time : 69 minutes

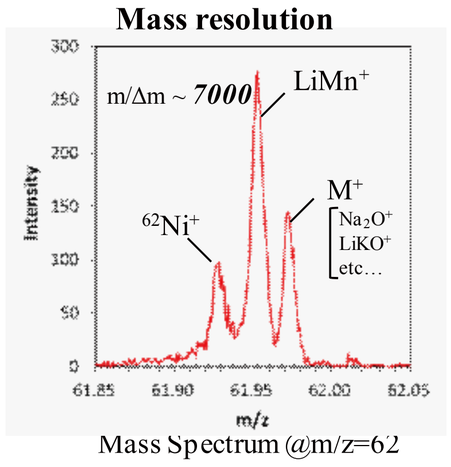


Cross section of D-RAM Al wiring



Ref.) T. Sakamoto et. all, *Applied Surface Science,* **2008,** *255,* 1617.

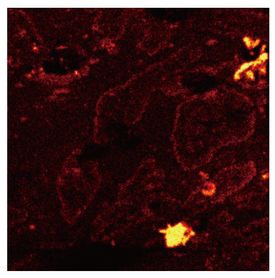




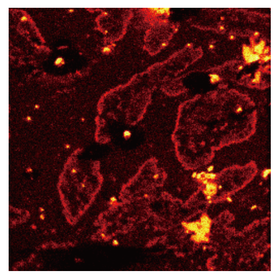
Mass Spectrum @m/z=62

Suspended Particulate Matter ($PM_{2.5}$)

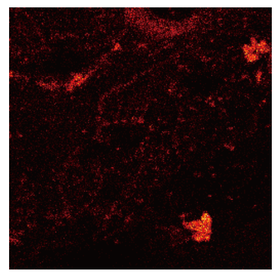
Positive Ion (FoV 50μm)



m/z=23 Na

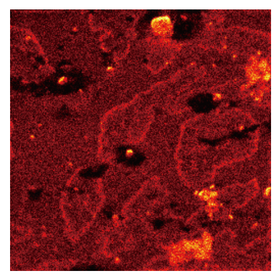


m/z=39 K

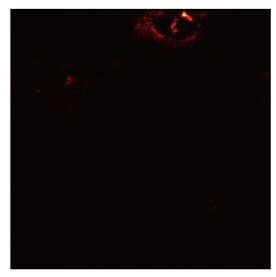


m/z=40 Ca

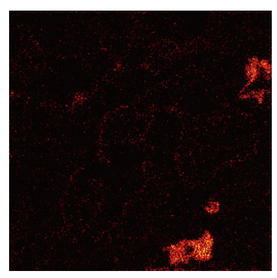
Negative Ion (FoV 50μm)



m/z=16 O



m/z=35 Cl

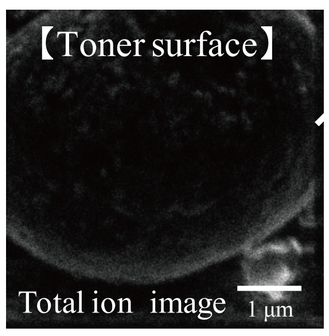


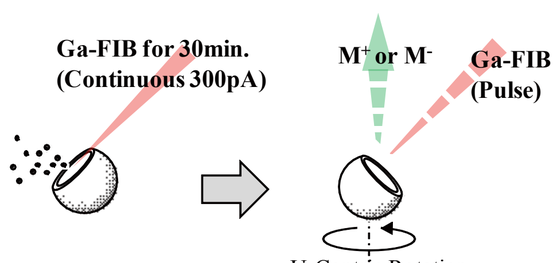
m/z=63 PO_2

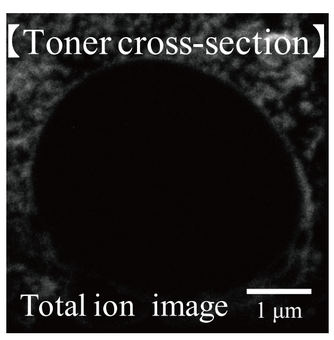
*Collected near TOYAMA, R&D Center

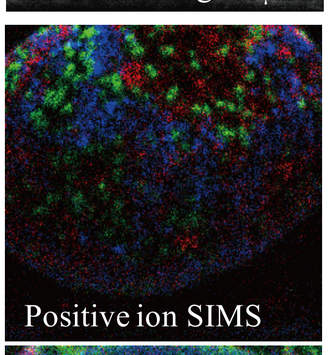
Collected on Si-wafers set on poly carbonate filter in $PM_{2.5}$ standard sampler

FIB Fine Processing can Extend the subject to be Analyzed.







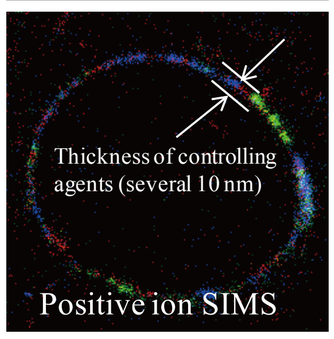


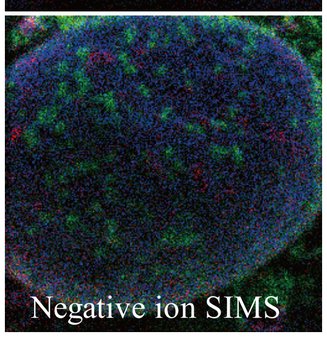
Detection of metal oxides from the surface (charge-controlling agents, migration-controlling agents)

Red; m/z = 27 Al^+

Green; m/z = 28 Si^+

Blue; m/z = 48 Ti^+





Red; m/z = 26 CN^-

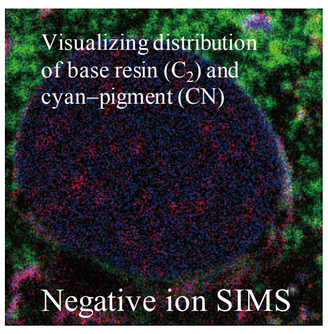
=>Fragment of Cu-Phthalocyanine (cyan-pigment)

Green; m/z = 16 O^-

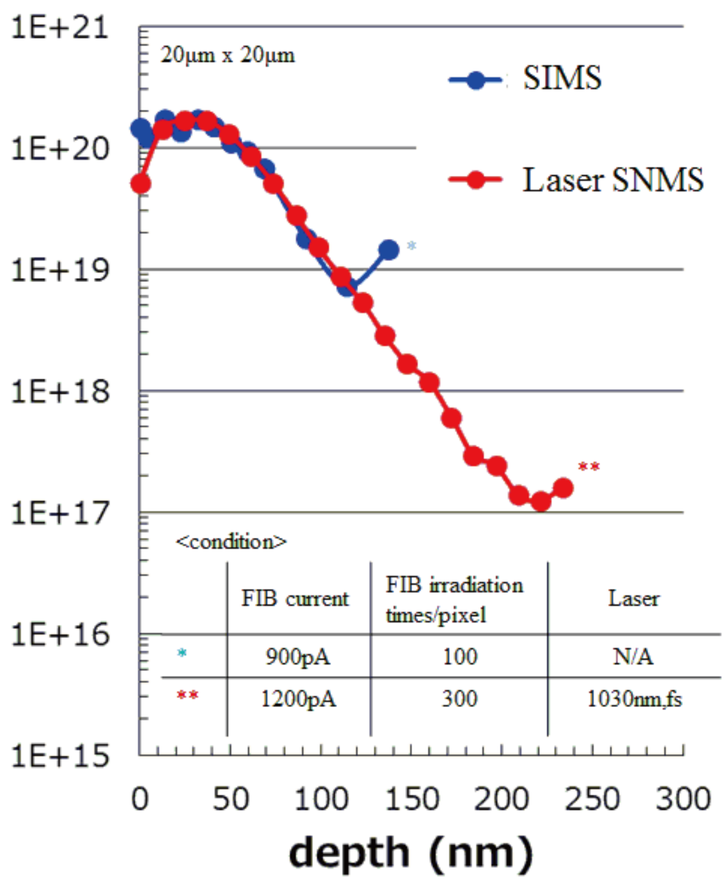
=>Distribution of oxygen and metal ions are identical

Blue; m/z = 24 C_2^-

=>Signals from base resin and wax



B-Doped Semiconductor

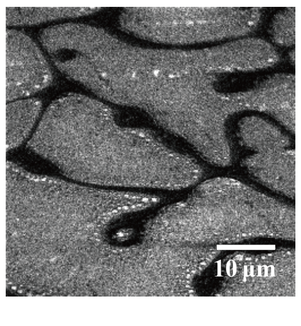


Practical Example of Laser SNMS on Polymer

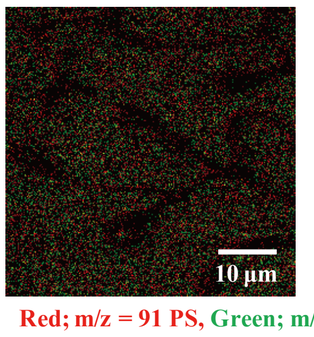
Nano scale mapping of phase separated structure of organic polymer mixture.

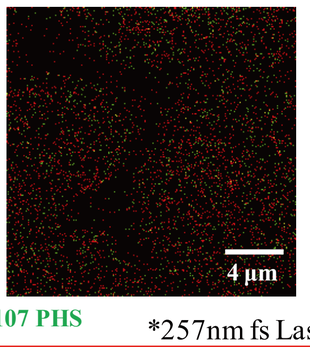
SIMS analysis Positive ion mode

Total ion image



Mass image



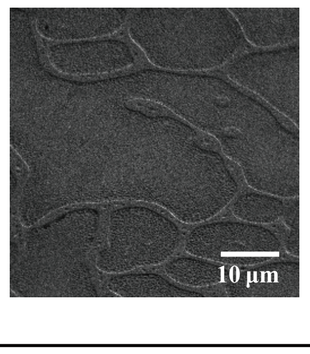


Red; m/z = 91 PS, Green; m/z = 107 PHS

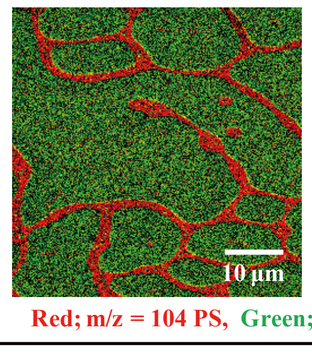
*257nm fs Laser

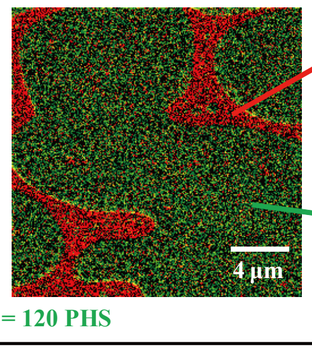
Laser SNMS analysis

Total ion image

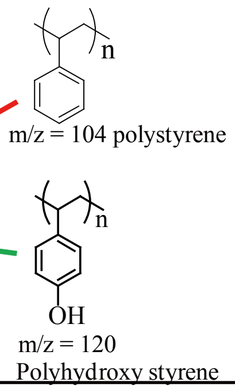


Mass image





Red; m/z = 104 PS, Green; m/z = 120 PHS

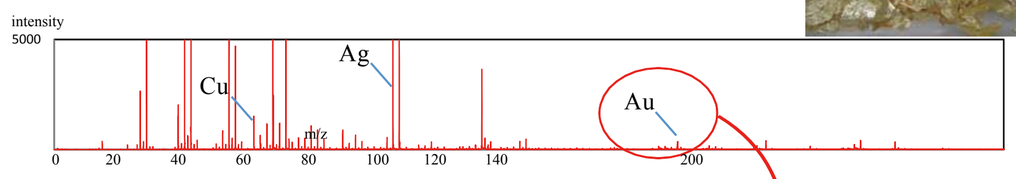


m/z = 104 polystyrene

m/z = 120 Polyhydroxy styrene

Detection Yields Up !! by Laser SNMS

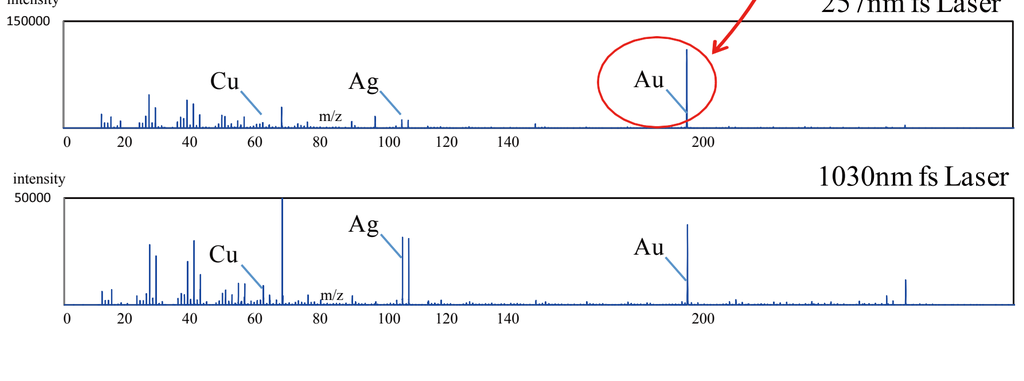
Positive ion SIMS m/z = 0 ~ 300



A few metal elements can hardly be ionized by Ga FIB-SIMS

180 times Larger

While using Lase SNMS …



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