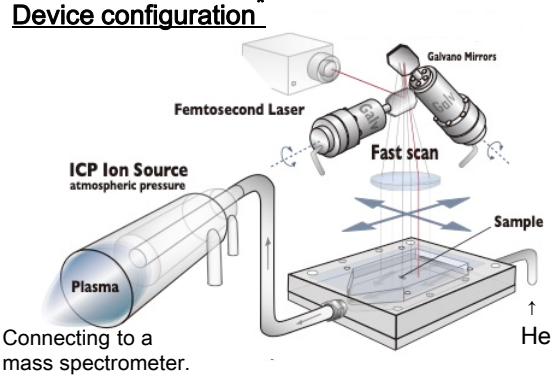
fsLA-ICP-MS analysis of inorganic trace elements in hard-to-digest sample

In conventional ICP-MS method, samples need to be dissolved in solution and it is difficult to applying this method to acid-insoluble materials such as wide-bandgap semiconductors.
To solve this problem, we introduced Femtosecond LA-ICP-MS(fsLA-ICP-MS) and acquire an ability to analyze trace elements in hard-to-digest samples.

Overview and features of fsLA-ICP-MS

Device configuration*



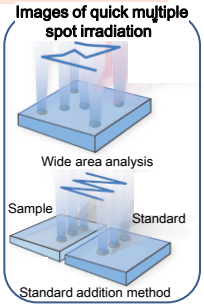
Connecting to a mass spectrometer.

Inorganic elements in tiny particle(=aerosol) which generated by irradiating laser on a solid sample are analyzed by ICP-MS.

	Nd:YAG laser	Femtosecond laser with galvanometric optics
Maximum frequency	20 Hz	60 kHz
Pulse width	2 ~ 20 ns	Some hundreds of fs
Aerosol size	0.1 ~ 10 μm	0.05 ~ 0.2 μm
Analyzable area = Crater size	⌀10 ~ 150 μm (Single spot)	⌀10 μm (Single spot) 20 mm x 20 mm (Quick multiple spot irradiation)

Features

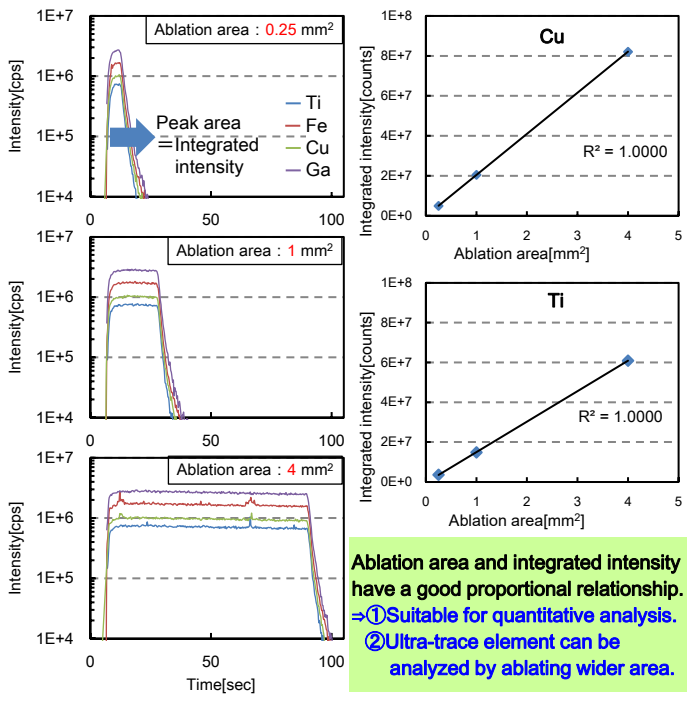
- Femtosecond laser generates finer aerosols than conventional laser does.
  ⇒It leads to more stable signal, higher sensitivity and lesser elemental fractionation.
- Galvanometric optics enables quick multiple spot irradiation.
  ⇒Wide area analysis and standard addition method with solid standard become possible.



Analysis of impurities in SiC wafer

Correlation between ablation area and signal intensity

Sample : Ion doped SiC wafer (Dopant: 1E+14 atoms/cm² of Ti, Fe, Cu and Ga)



Ablation area and integrated intensity have a good proportional relationship.
⇒①Suitable for quantitative analysis.
②Ultra-trace element can be analyzed by ablating wider area.

Reproducibility of ablation depth

Ablation depths after analyzing 3 spots on SiC wafer.

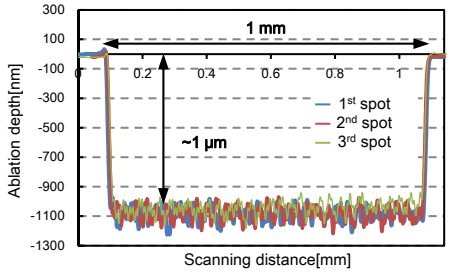


Fig.1 Ablation depth measured by profilometer

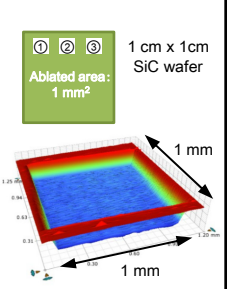
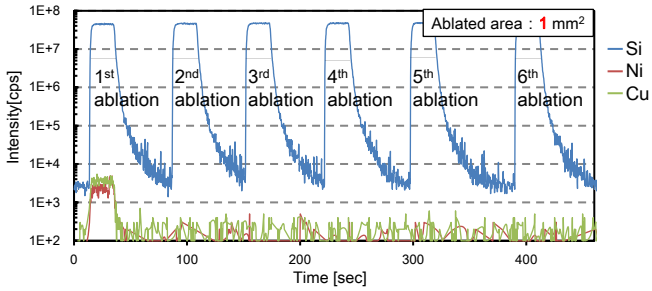


Fig.2 3D mapping

Ablation depth shows good reproducibility.

Depth profile of metal impurities in SiC wafer

Results of same spot analysis through 6 times ablation.



Elements' depth profile can be achieved without sample dissolving.

*) These images provided by professor Takafumi Hirata, University of Tokyo.

fsLA-ICP-MS gives us a way to analyze trace elements in hard-to-digest materials with high accuracy and swiftness.

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