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Plasma Profiling-TOFMS

New Fast Depth Profiling Technique

PP-TOFMS couples a glow discharge plasma to an ultra-fast time of flight mass spectrometer and provides chemical analysis of solid materials as function of depth.

◆ Fast and Direct analysis

A rapid erosion plasma combined with an ultrafast detection is the key to analyzing samples in minutes. In addition samples are measured directly without any preliminary preparation or transfer into a UHV chamber.

◆ All types of materials

The use of RF excitation permits the analysis of conductive and insulating, inorganics, organics, and hybrides materials or layers, e.g. thin layers on thick glass substrates.

◆ Full mass coverage

In contrast with sequential mass spectrometers, TOFMS offers full mass spectrum offering elemental (from H to U) and molecular information, including isotopic monitoring at any depth even for the thinnest layers.

◆ Unique 3D data

The glow discharge is operated in pulsed RF mode (patented) thanks to an innovative matching system combined with a high performance acquisition electronics and software. The temporal ion response over the RF source period is capitalised for high sensivity and to minimize isobaric interferences.

◆ High depth resolution

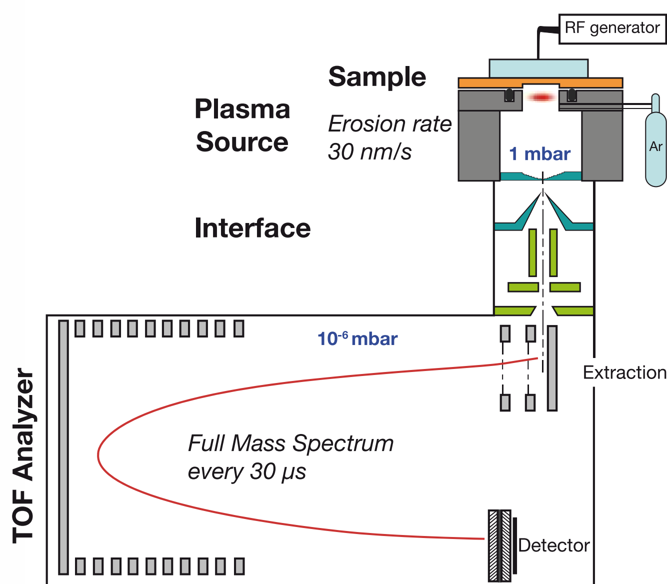
Despite the mm size crater formed, layers as thin as 1 nm are measured.

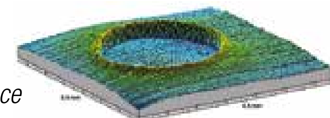
◆ Thin to thick layers

The high density plasma results in high sputtering rate and allows for measuring thick layers up to 100 µm.

◆ Semiquantitative analysis

Minimal matrix effects due to the separation of sputtering and ionisation processes in the discharge volume give the capability of a calibration free semiquantitative analysis.





Crater created on sample surface

Applications

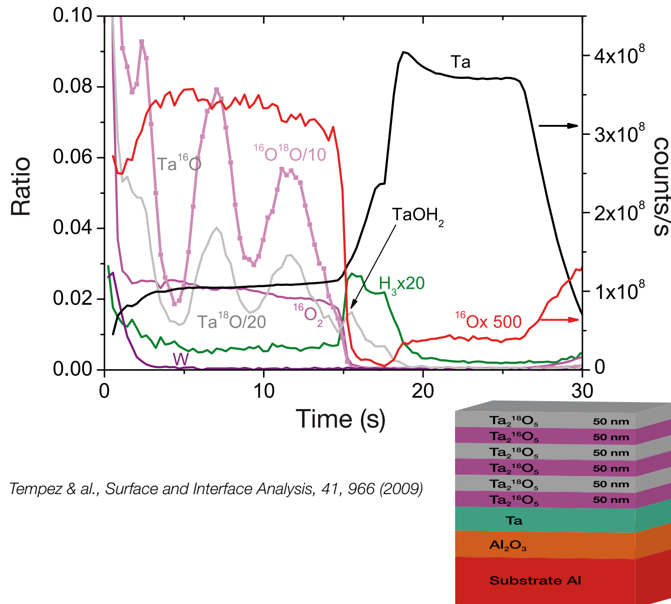
- Nanostructures characterisation
- Dopants profiling
- Surface and bulk contaminants identification
- Corrosion science and technology

Specifications

- Acquisition rate: 33 kHz to cover elements up to U (a full spectrum every 30 µs)
- Mass Resolving power: 3500 at m/z 208; high resolution 5000 at m/z 208
- Dynamic range: 10^7
- Mass accuracy (m/z error / true m/z): 40 ppm
- Sensitivity: 10^3 cps/ppm
- Depth resolution: nm
- Both negative and positive ion modes
- Flexible blanking capability up to 4 ions
- Easy and horizontal sample mounting

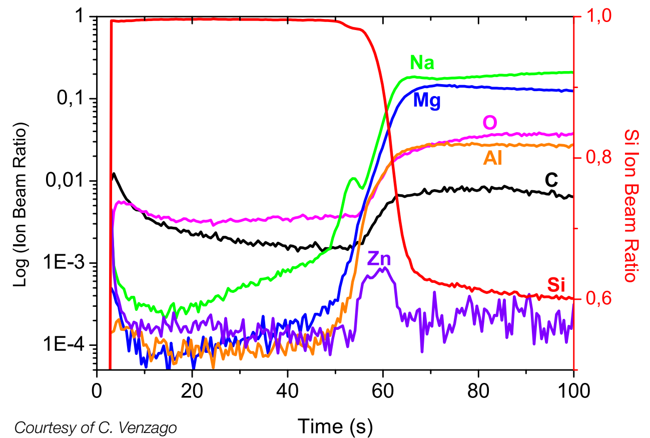
Examples

Isotopic Profiling in ^{18}O enriched Tantalum Oxide



Tempez & al., Surface and Interface Analysis, 41, 966 (2009)

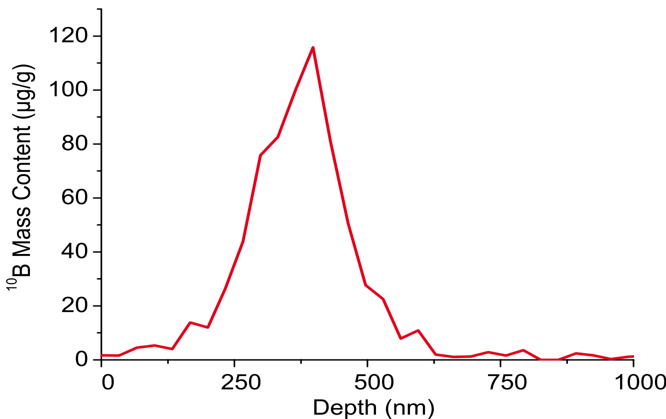
Impurities identification in Si PV



Courtesy of C. Venzago

Quantitative implanted Boron in Si

100 keV $^{10}B^+$ - 10^{14} atom/cm^2 - Depth profile in 15 seconds



Pisonero et al, Solar Energy Materials and Solar Cells, 94, 1352 (2010)

Mg in InGaN quantitative measurement

Up to mid 10^{18} at/cm^3 upon calibration

Sample	Electrolytic Capacitance Voltage	PP-TOFMS
A1	3.8×10^{20}	$3.9 \times 10^{20} \pm 2.1 \times 10^{19}$
A2	--	$4.0 \times 10^{20} \pm 2.8 \times 10^{19}$
A3	1.7×10^{20}	$2.6 \times 10^{20} \pm 1.3 \times 10^{19}$
A4	4.4×10^{18}	$4.6 \times 10^{18} \pm 1.6 \times 10^{18}$
A5	1.8×10^{20}	$2.1 \times 10^{20} \pm 1.0 \times 10^{19}$

Courtesy of Prof. Bensaoula, University of Houston

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