

*TOF.SIMS<sup>5</sup>*

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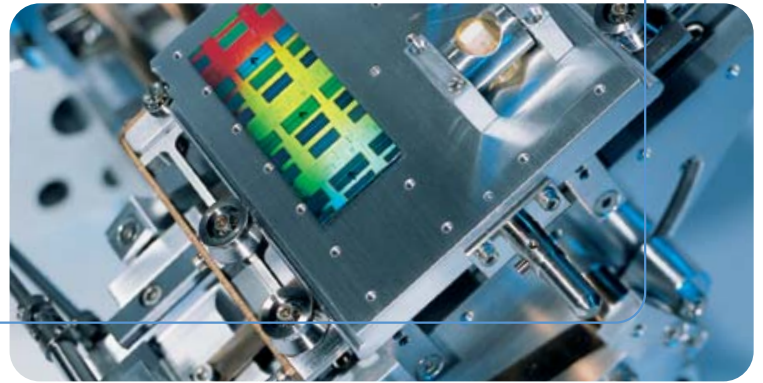
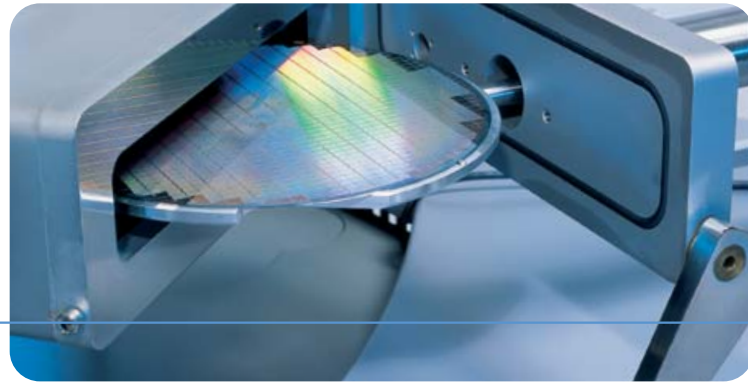
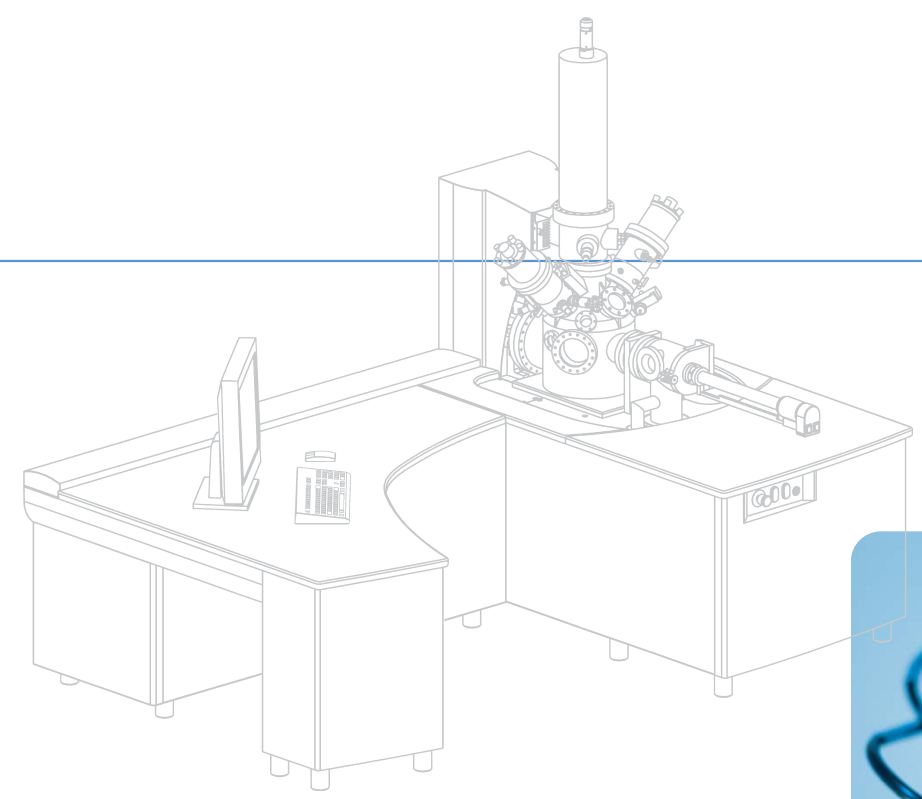


# TOF.SIMS<sup>5</sup>

Superior Performance for all SIMS Applications

Time-of-flight secondary ion mass spectrometry (TOF-SIMS) is a very sensitive surface analytical technique, well established for many industrial and research applications. It provides detailed elemental and molecular information about surfaces, thin layers, interfaces, and full three-dimensional analysis of the samples. The use is widespread, including semiconductors, polymers, paint, coatings, glass, paper, metals, ceramics, biomaterials, pharmaceuticals. The TOF.SIMS 5 is the fifth generation of high-end TOF-SIMS instruments developed over the last 20 years. Its design guarantees optimum performance in all fields of SIMS applications. Unique features of the TOF.SIMS 5 are:

- Ultra high sensitivity for molecular species by optimised cluster ion sources
- Outstanding performance for low energy depth profiling
- \*Sophisticated software for ease of operation and data handling
- \*Modular construction for configuration and upgrade flexibility
- Ergonomic design with compact footprint

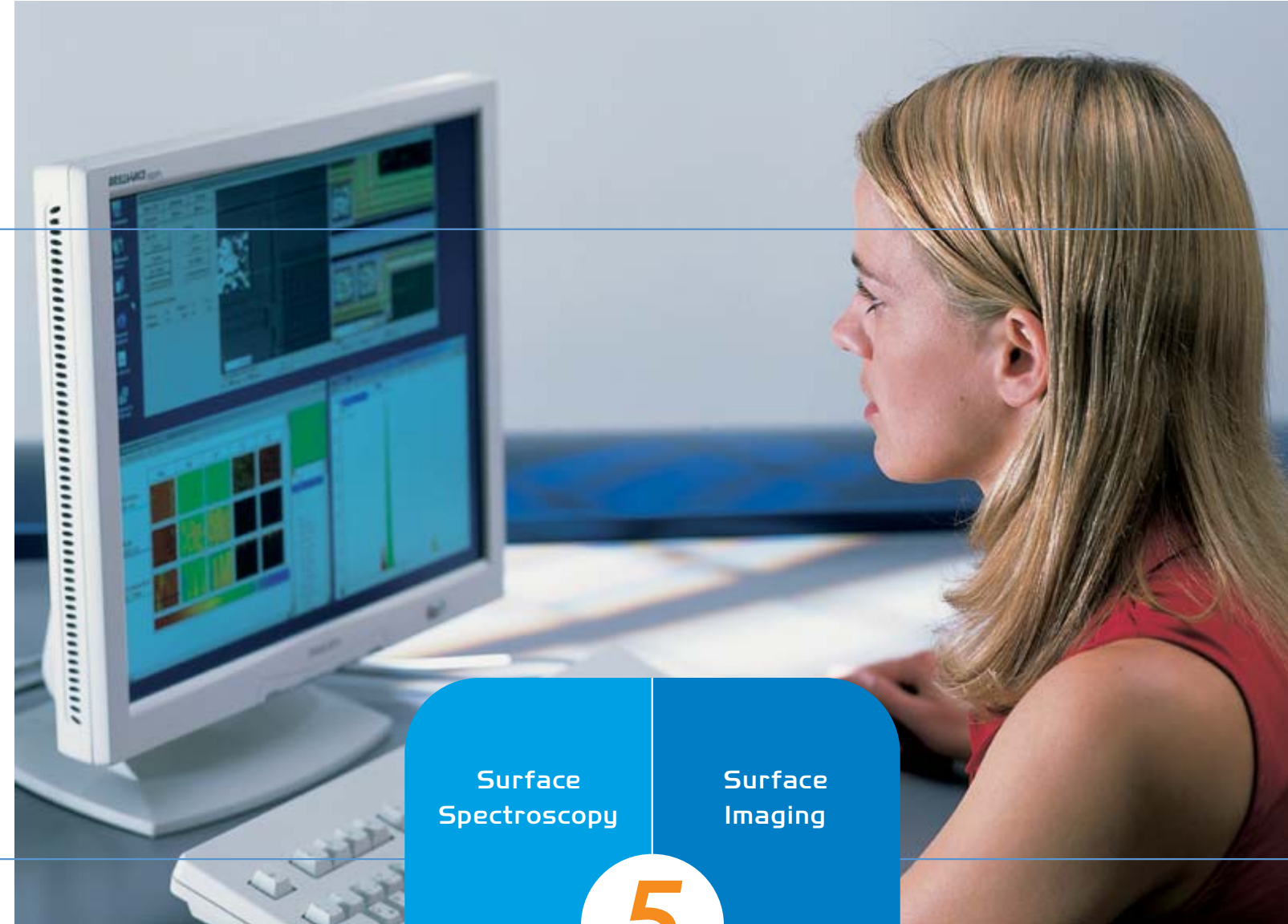
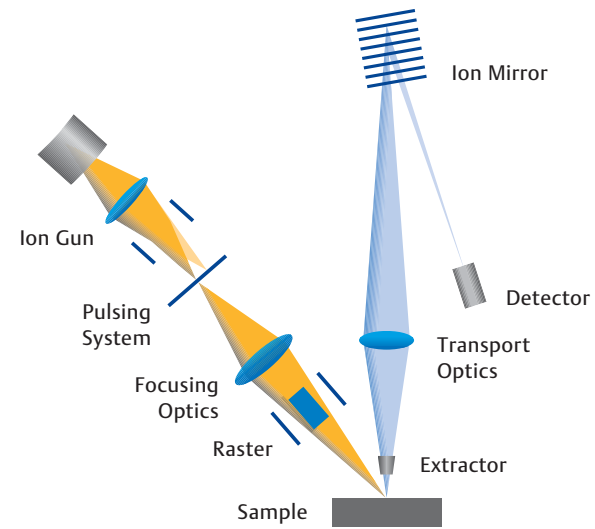




## Time-of-Flight Analysis

For TOF-SIMS analysis, a solid sample surface is bombarded with a pulsed primary ion beam. Both atomic and molecular ions are emitted from the outer layers of the surface and extracted. Their mass is measured by their time of flight to the detector. This analysis cycle is repeated at high frequency to generate the complete mass spectrum with high dynamic range. Based on this principle the TOF.SIMS 5 has a powerful combination of characteristics.

- Parallel detection of all ions, organic and inorganic
- Unlimited mass range
- High mass resolution at full transmission
- High lateral and in-depth resolution
- High sensitivity in the ppm/ppb range



Surface Spectroscopy

Surface Imaging

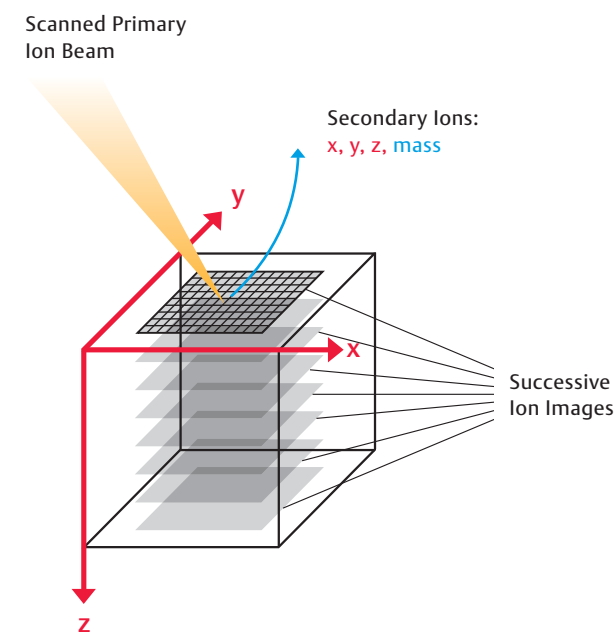
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Depth Profiling

3D Analysis

### Don't miss anything — Retrospective Analysis

As well as comprehensive on-line analysis, the parallel mass detection of the TOF.SIMS 5 provides the means to carry out Retrospective Analysis. Regardless of the knowledge about the sample before measurement, the data can be explored afterwards to look for unexpected results, such as unknown structures, contaminants at interfaces and so on. The x, y, z coordinates and mass of every secondary ion reaching the detector are stored. The software can reconstruct spectra from any coordinate or group of coordinates, images from any section, vertical or horizontal, depth profiles from any selected area and various 3D views as required.



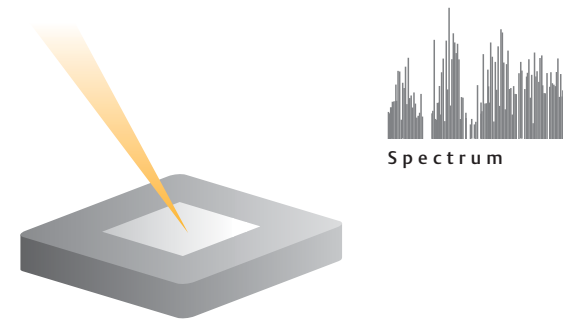
Get the full picture **TOF.SIMS<sup>5</sup>**

The great flexibility of the TOF.SIMS 5 is demonstrated by its four integral modes of operation. Few techniques have the capability to analyse points, surfaces, in-depth and in three dimensions. Covering a very wide range of applications it provides fast, cost-effective and often unique solutions for your analytical tasks.



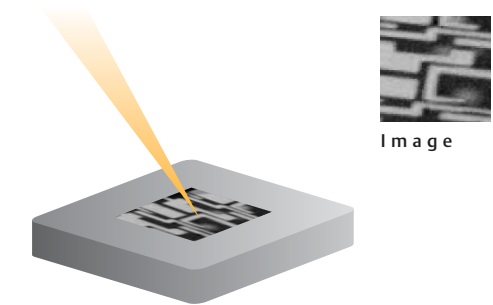
Surface Spectroscopy provides detailed elemental and molecular information from the outer monolayers.

- Variety of primary ion species (Ga, Bi<sub>n</sub>, O<sub>2</sub>, Cs, Ar, Xe, SF<sub>5</sub>, C<sub>60</sub>)
- High sensitivity in the ppm/ppb range
- High mass resolution and accuracy even on insulating samples
- High mass range



For Surface Imaging a fine-focused primary ion beam scans the surface resulting in mass resolved secondary ion images (chemical maps).

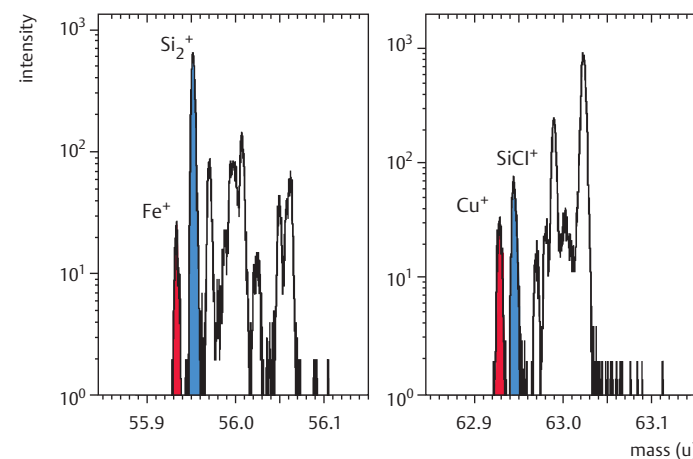
- High lateral resolution (< 60 nm)
- High precision raster (up to 1024 x 1024 pixel resolution)
- Fast image acquisition (up to 50 kHz pixel frequency)
- Video control for precise sample navigation
- Field of view from m<sup>2</sup> to cm<sup>2</sup>



## Examples

### Trace Metals

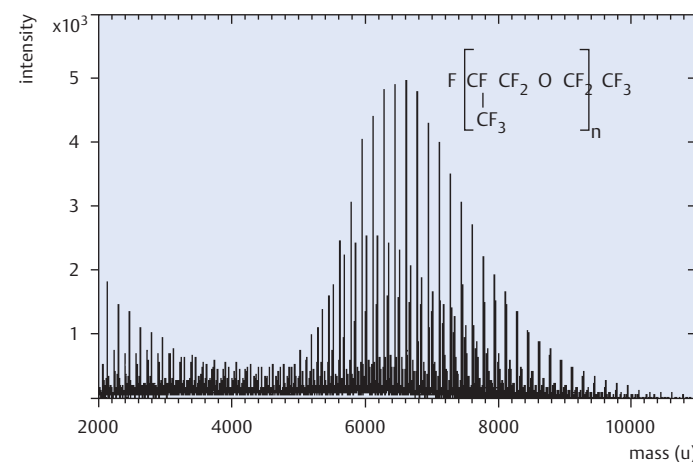
The detection and quantification of trace metals is an important analytical task in the semiconductor industry. The TOF.SIMS 5 is able to detect all elements, even light ones. Due to the high mass resolution and the very low noise level, excellent detection limits down to 10<sup>7</sup> atoms/cm<sup>2</sup> can be obtained. These limits are achieved even from small areas and the TOF.SIMS 5 can therefore be applied to patterned wafers. By using external standards, good quantification is obtained.



**Details of a spectrum from a Silicon wafer surface.**  
High mass resolution and accuracy allow the unambiguous identification of trace metals.

### Organic Materials

Many technological fields require the understanding and processing of the molecular structure of surfaces. Static SIMS is the ideal analytical technique because it detects both large, complex molecular ions and fragment ions with ultimate sensitivity to provide detailed structural information. The excellent transmission of the TOF.SIMS 5 analyser, the high mass range and advanced cluster ion sources make the TOF.SIMS 5 the perfect tool for organic materials such as polymers, biomaterials, pharmaceuticals...



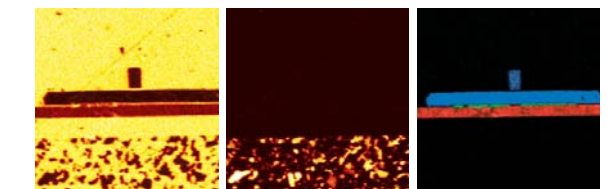
**Spectrum of a high-tech lubricant (fluorinated polyether)**  
showing the oligomer distribution in the high mass range.

## Examples

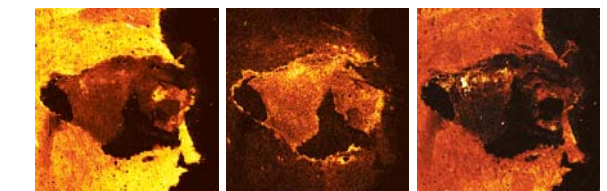
### From Sub-Micron to Large Area

The chemical mapping of elements and molecules is an important part of many modern analytical tasks. The TOF.SIMS 5 covers the full range of SIMS imaging applications, including elemental imaging, organic imaging with optimised cluster ion sources, and large area mapping by sample stage raster. Horizontal sample orientation, large motorised 5-axes sample stage, and charge neutralisation are ideal for the analysis of all kinds of real world samples, so there are no limitations due to shape, topography, or electrical conductivity. Flexibility and performance make the TOF.SIMS 5 the instrument of choice for all SIMS imaging applications.

**Hard disk read/write head.**  
Field of view: 25 x 25 μm<sup>2</sup>

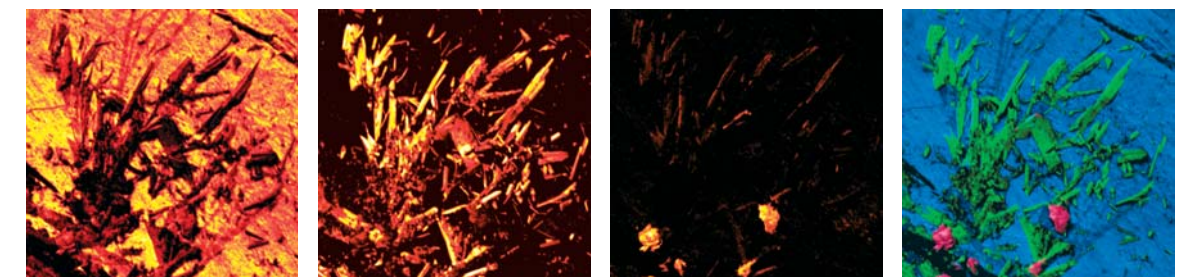


**Animal brain tissue.**  
Field of view: 4 x 4 mm<sup>2</sup>



Fatty acid residues    Blood components    Phospholipids

**Blooming effect of additives on formed polypropylene.**  
Field of view: 300 x 300 μm<sup>2</sup>



Polypropylene (PP)    Antioxidant    Stabiliser    Overlay: PP, Antioxidant, Stabiliser

### Sample Navigation

The TOF.SIMS 5 provides excellent sample observation and navigation features. Two video cameras for real-time sample viewing, pre-loading high resolution sample scanner, ion induced secondary electron imaging and sophisticated navigation software supply all information necessary for precise sample positioning. The software complies with the data standard of all defect review tools.





# Depth Profiling

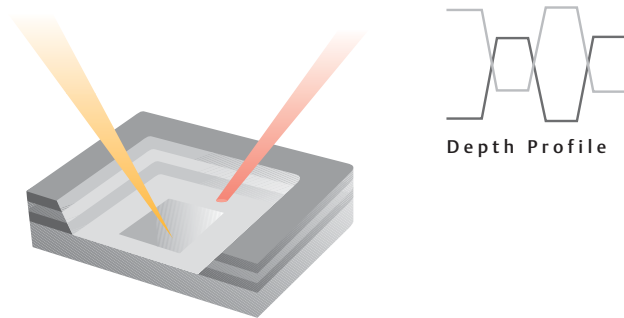
Dynamic SIMS

# 3D Analysis



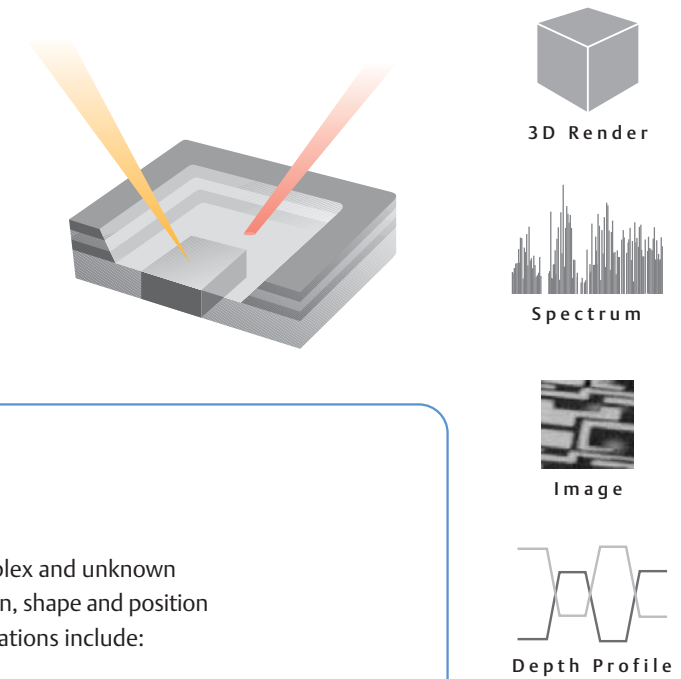
For Depth Profiling two ion beams operate in the Dual Beam Mode. While the first beam is sputtering a crater, the second beam is progressively analysing the crater bottom.

- Depth resolution better than 1 nm
- High mass resolution
- Sputter speed of up to 10 m/h
- Ideally suited for insulators



The 3D visualisation of complex sample structures is possible by combining spectral, imaging and depth information.

- Parallel mass detection
- High depth resolution
- High image resolution
- 3D rendering software



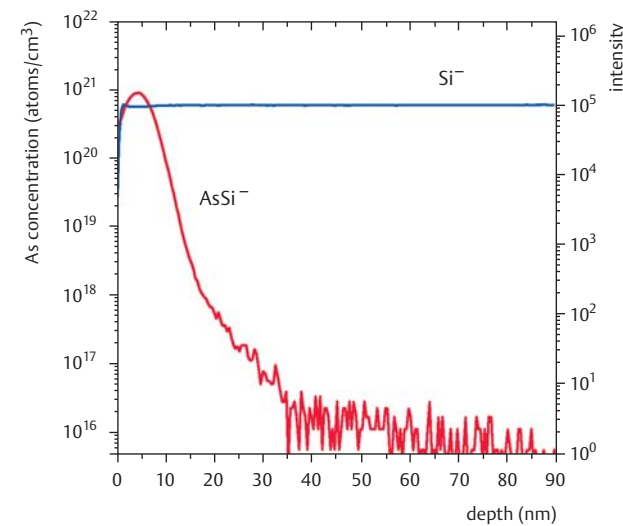
## Examples

### Dual Beam Depth Profiling

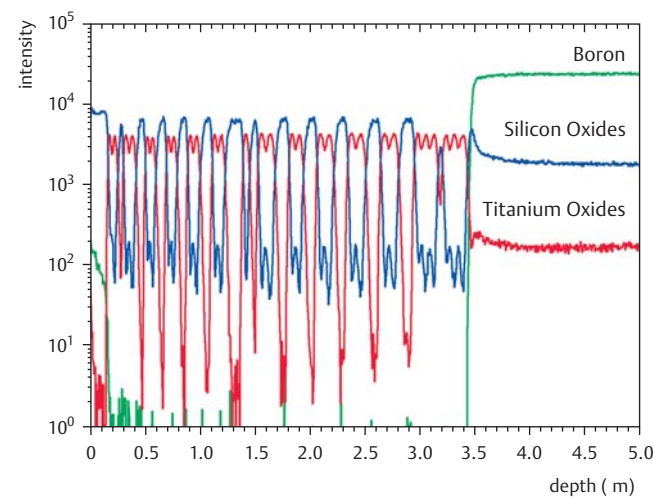
The major advantage of dual beam depth profiling is that both ion beams can be optimised separately. While the sputter ion beam is optimised for delivering high and stable currents at low energies using reactive species, the analysis ion beam (Liquid Metal Ion Gun) is optimised for lateral and mass resolution.

For high depth resolution the sputter ion column can operate at very low energies. Maximum data rates with a repetition frequency of up to 50 kHz give detection limits down to  $10^{15}$  atoms/cm<sup>3</sup> even for ultra-shallow systems. At higher sputter beam energy, samples of considerable thickness can be analysed within a reasonable measurement time. Due to the very efficient electron flood gun, perfect charge compensation is reached for profiling all types of insulating samples.

High mass resolution in combination with the Retrospective Analysis makes the TOF.SIMS 5 a very powerful depth profiling tool for multi-component-layered samples, contaminant screening, diffusion profiling and unknown samples.



Depth profile of a 3 keV Arsenic implant in Silicon. 500 eV Cesium sputtering



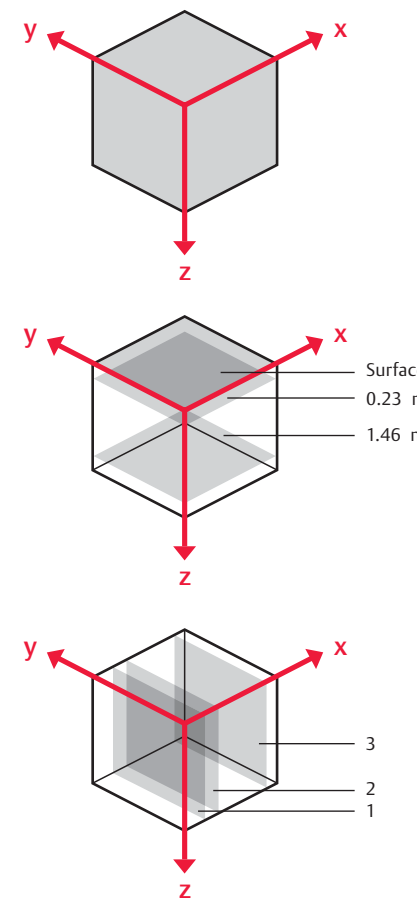
Depth profile through a multilayer coating on a halogen spotlight reflector.

## Example

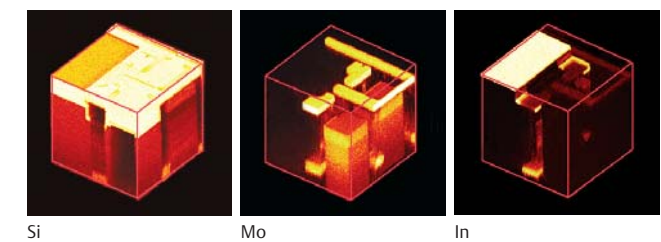
### 3D Analysis

3D Analysis is ideal for the investigation of complex and unknown structures or defects. In particular the composition, shape and position of features and defects can be visualised. Applications include:

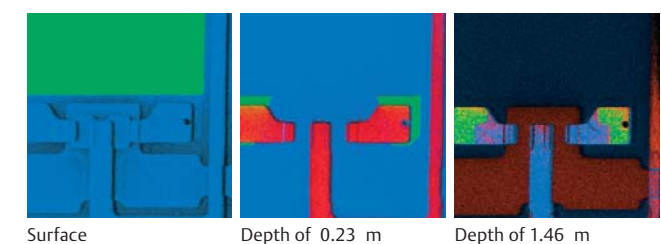
- **Manufactured structures:** TFT displays...
- **Defect Analysis:** buried particles...
- **Material Science:** grain boundaries, diffusion...



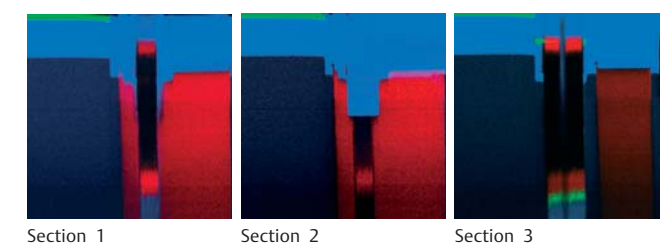
Mass resolved 3D view of a TFT display pixel. Analysed volume 100 x 100 x 1.7 m<sup>3</sup>



Overlays (Si, Mo, In) of horizontal cross sections



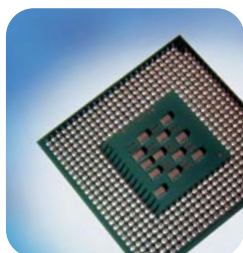
Overlays (Si, Mo, In) of vertical cross sections



## Analysis Unlimited

### Staying Ahead

Modern life is characterised by continuous development and technological change. The capacity for understanding, controlling and taking advantage of new ideas is essential. As a result, analytical instrumentation has to expand its performance to fulfill current and future analytical demands. The TOF.SIMS 5 provides solutions for many of today's high-tech industries. Our mission is to develop the technique and expand its potential for future applications. Considerable research effort as well as close co-operation with our customers will continue to create new possibilities, thus keeping our instruments at the leading edge of technology.



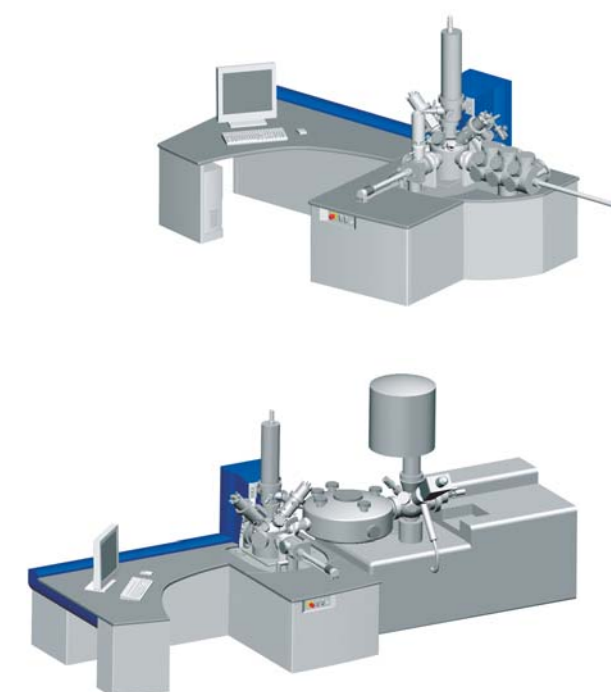
# TOF.SIMS<sup>5</sup>

## Features and Accessories

- Sample size up to 100 mm, 200 mm and 300 mm
- 5-axes sample stage
- Modular construction with configuration flexibility
- Wide range of ion sources: Ga, Bi<sub>n</sub>, O<sub>2</sub>, Cs, Ar, Xe, SF<sub>5</sub>, C<sub>60</sub>
- Temperature controlled heating and cooling of the sample during the analysis
- Temperature controlled heating and cooling of the sample in the loadlock
- Cryo sample transfer
- Cs-Xe co-sputtering
- Laser post-ionisation
- 20 kV post-acceleration
- Patented Burst Mode
- Windows™ operating system
- Comprehensive software package incl. spectra library and search engine
- Real-time sample observation
- Pre-loading high resolution sample scanner
- Charge compensation by electron flood gun
- Ion induced secondary electron imaging
- High precision raster with up to 1024 x 1024 pixels
- Up to 50 kHz repetition frequency
- Ergonomic design with compact footprint
- Internal bakeout
- Modular electronics for plug-in maintenance
- Oil and water free low noise vacuum system
- High uptime and easy maintenance

## Customised Configurations

ION-TOF listens to its customers, and has a strong tradition of collaboration with them to incorporate new ideas for hardware and software. The modular design of the TOF.SIMS 5 is ideal for customisation. In particular due to the horizontal sample concept a large variety of UHV sample preparation chambers can easily be coupled to the instrument. These chambers can also be used to accommodate complementary analysis techniques such as XPS or AES. It is also possible to couple the TOF.SIMS 5 to other floor standing high-end instruments.



Materials	Tasks	Areas of Applications
Semiconductors	Failure Analysis	Contamination
Polymers	Quality Control	Adhesion
Paint and Coatings	Development	Friction
Biomaterials	Reverse Engineering	Wettability
Pharmaceuticals	Research	Corrosion
Glass	etc.	Diffusion
Paper		Segregation
Metals		Cell Chemistry
Ceramics		Biocompatibility
etc.		etc.



## The Company

ION-TOF is the leading European manufacturer of TOF-SIMS instruments for surface analysis.

The company was founded in 1989 by Prof Alfred Benninghoven, Mr Thomas Heller and Dr Ewald Niehuis to commercialise the original research carried out at the University of Muenster in Germany started in the early 1980's.

Since the technique became commercially available ION-TOF has made many product improvements, and more than 160 instruments are in operation in industrial and academic laboratories worldwide. ION-TOF's success is based on the longstanding SIMS experience and skills of its scientists and engineers, the support given to customers and the close cooperation with them, and a dedication to supply a good, efficient product to match the demands of modern users.

ION-TOF continues to make considerable development effort in order to bring to the market the most innovative ion beam technology for surface analysis.

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