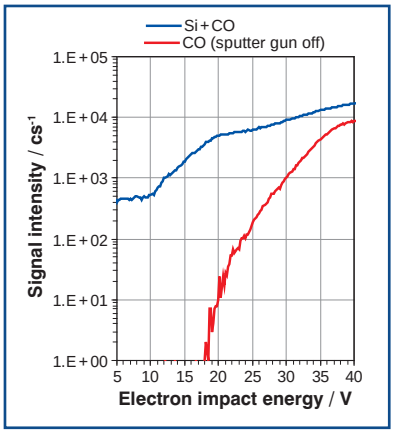
Hiden SIMS

HIDEN ANALYTICAL

SNMS

Sputtered Neutral Mass Spectrometry is a quantitative technique using essentially the same instrumentation as SIMS. However, instead of detecting the secondary ions which are formed at the time of sputtering and whose number depend very strongly on the sample chemistry, SNMS detects the neutral fraction of the sputtered material. An electron impact ioniser, located in the entrance of the spectrometer, ionises sputtered neutral atoms with constant efficiency, thus overcoming the SIMS matrix effect.

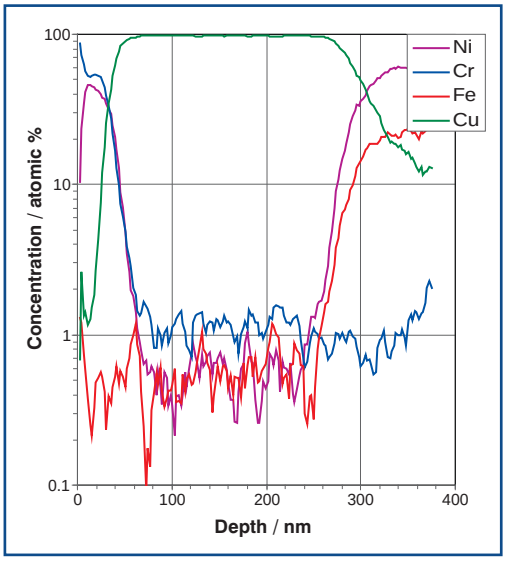


The ability to vary the electron impact energy permits appearance energy to be used to separate some mass interferences, such as ^{28}Si from $^{12}C^{16}O$.

SNMS Applications

The direct quantification of concentration over the range 0.01% to 100% makes SNMS useful for the measurement of optical and metallurgical coatings, alloys, corrosion layers and architectural glass coatings.

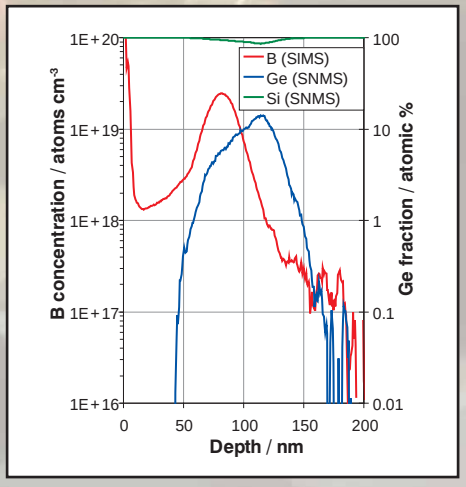
With no matrix effect, calibration is made using widely available alloys and compounds containing the elements of interest. In addition, SNMS has good depth resolution and isotopic sensitivity.



Magnetic layers - SNMS with 5keV Ar^+ primary ions was used to provide a quantified analysis of a NiCr/Cu/NiFe layer structure. The reference materials for such an analysis are easily available alloys, ensuring a fast, accurate and economic route to complete quantification.

Combined SIMS and SNMS

It is possible to combine SIMS and SNMS measurements in the same measurement cycle such that impurities are detected with the high sensitivity of SIMS and matrix elements are quantified directly by SNMS. In this example SIMS is used to collect the boron dopant profile whilst SNMS monitors the SiGe matrix.



SIMS

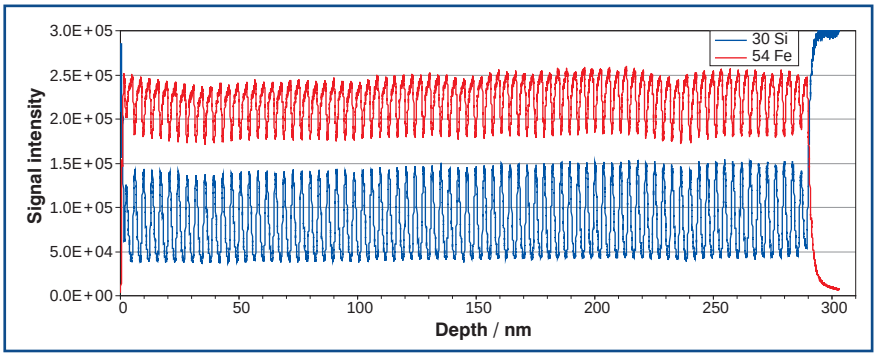
Secondary Ion Mass Spectrometry is the most sensitive surface analysis technique with detection limits for many elements in the ppb range. Samples are bombarded by an ion beam under ultra-high vacuum conditions and the sputtered material, characteristic of the surface, is detected by mass spectrometry. SIMS detects all elements and isotopes.

With a very low primary ion dose, SIMS is sensitive to the uppermost monolayers making it ideal for the detection of surface contamination. As the primary ion dose increases, sputtering of the surface exposes deeper material and a depth profile may be recorded with nanometre depth resolution.

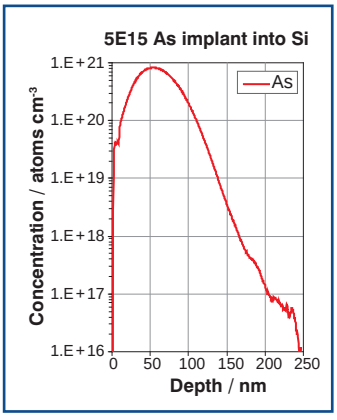
This enables quantitative analysis of layer structures, corrosion features, material diffusion and impurity distributions (e.g. semiconductor dopants) as well as bulk analyses to be acquired. When the secondary ion signal is correlated with the primary ion position then mass resolved images are recorded.

SIMS Applications

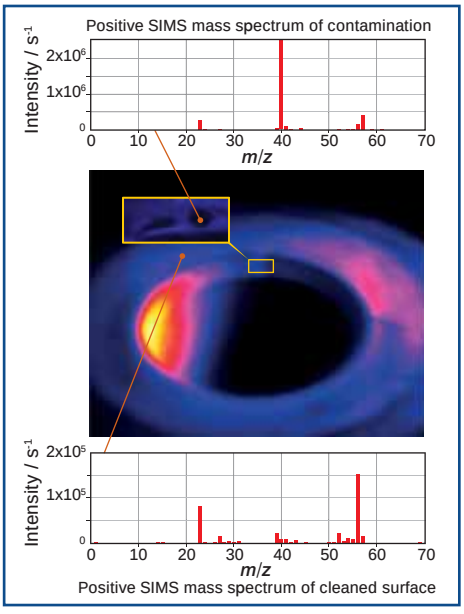
SIMS finds application in research, development and production across a wide range of industries including semiconductors, glass coatings, photovoltaics, gem stone verification, geology and metallurgy. In the static SIMS mode the fragmentation patterns of larger molecules lead to unique fingerprint spectra applicable to polymer and biological materials.



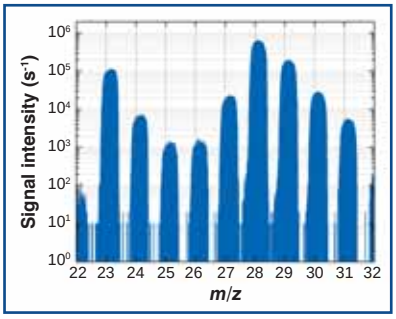
Depth resolution - nanometre depth resolution is achievable making characterisation of thin layers possible. The plot shows the depth profile obtained with the IG20 and MAXIM, using 1.5keV oxygen ions normally incident to the sample surface of a neutron mirror with 160 alternating 1.8nm thick layers. There is no loss of depth resolution with depth and all layers are observed.



Dopant depth profiling - SIMS detects and quantifies semiconductor dopants and impurities with high sensitivity and accuracy making it suitable for the study of redistribution and diffusion phenomena as well as production monitoring. The analysis shown was made using 5keV Cs^+ primary ions from the IG5C whilst collecting $AsSi^-$ secondary ions.



The ^{56}Fe image of a hard steel engine component shows Fe, Cr (and Na and K) on the clean surface. A mass spectrum in the region of a stain, which masks the iron signal, shows surface contamination by calcium - a bio-diesel contaminant.



Positive SIMS mass spectrum from Si target, 5keV Ar^+ primary ions.

Hiden Surface Analysis

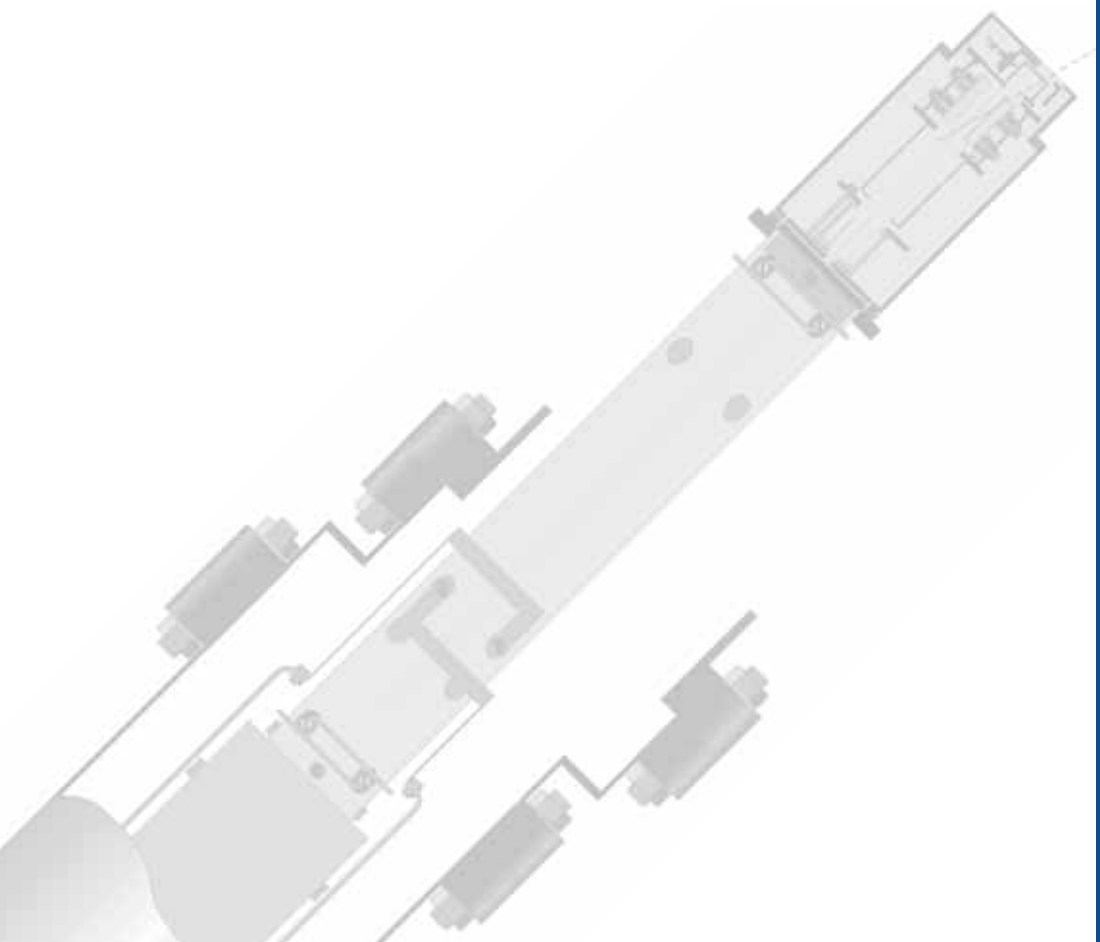
Hiden surface analysis products are available as complete systems, sub-assemblies and individual components. The products combine high performance and ease of use with unparalleled flexibility. Hiden can provide customisation for specific research needs or process monitoring requirements, ensuring optimised performance tailored to your application.

The range of ion guns and spectrometers provides for static SIMS (secondary ion mass spectrometry), depth profiling SIMS and SNMS (sputtered neutral mass spectrometry) as well as offering mass and energy resolved detection for low energy ISS (ion scattering spectroscopy).

The ion guns and spectrometers are controlled via a PC interface enabling previous control parameters to be recalled and used. This feature makes the tools ideal for process monitoring applications and ensures that even inexperienced users can get useful data with a minimum of instruction, whilst experienced researchers can build complex analytical process flows using the highly flexible MASsoft control system.

SIMS-on-a-Flange

A SIMS instrument on a DN150 flange combines the EQS and IG20/IG5C with optional camera viewing and electron flood.



The Hiden SIMS Workstation

IG5C - Caesium Ion Gun

Caesium primary ions are essential for sensitive detection of electronegative elements. The IG5C provides ions up to 5keV from an air stable, low power, ion source. A user-serviceable aperture enables the gun to be configured for small spot and high current modes.

IG20 - Gas Ion Gun

Oxygen for sensitive electropositive element detection.

Inert gas for cleaning, SNMS and SIMS.

Sample Viewing

Clear view of the sample is essential for accurate targeting of features for analysis.

Normal incidence lighting and camera for undistorted view.

The Hiden SIMS Workstation is a stand-alone, general purpose, UHV SIMS/SNMS analysis system based around the MAXIM analyser. The instrument is both powerful and easy to use with a self-tuning secondary ion column and software controlled ion guns. A normally incident video camera enables accurate sample navigation and a low energy electron flood provides trouble free analysis of insulators. The instrument is available with a choice of ion guns and sample holders enabling customers to specify the tool most suited to their application.

The use of standard UHV components throughout ensures that the system can be easily upgraded and reconfigured, ideal for research applications as well as providing a future-proof investment. A soft tent bakeout system with integrated heater ensures UHV performance and, where required, the stand-alone pumping trolley may be mounted “through the wall” for clean room installation.

Sample Holder

Designed to hold the sample surface at a fixed (and optimum) distance irrespective of sample thickness. This ensures reproducible detection efficiency, a necessity for accurate quantification. Standard sample holders take 5 or 10 samples and custom holders are readily manufactured.

Loadlock

A fast entry UHV loadlock with a large door and magnetically coupled sample transfer system with additional port for gauge or other fitment and DN63 port for direct mounting of a turbo-molecular pump.

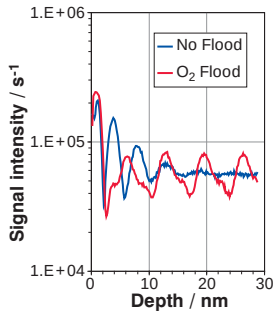
EQS Spectrometer

Mass and energy resolving with high sensitivity collection optics suitable for general purpose SIMS, surface science and focussed ion beam SIMS (FIB-SIMS) applications.

DN63 Fitting with on-axis collection and 45° electrostatic sector energy filter.

Customised lengths available.

Software and Control



Oxygen Flood

A directed jet of oxygen can be used to improve the ion yield and reduce surface roughness under some conditions.

The graph above shows effect of oxygen flood on a layered silicon structure analysed with 2keV oxygen primary ions at 45°.

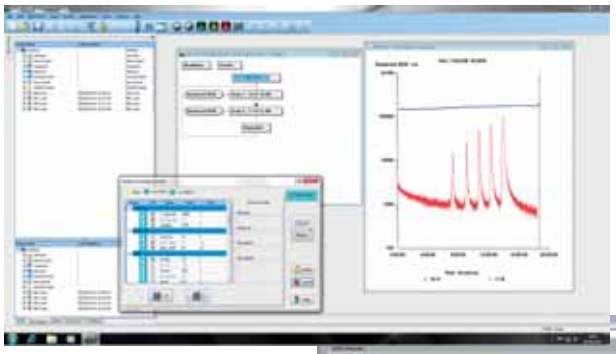
MAXIM Spectrometer

Optimum energy bandwidth for highest sensitivity analysis and integrated electron impact SNMS ioniser.

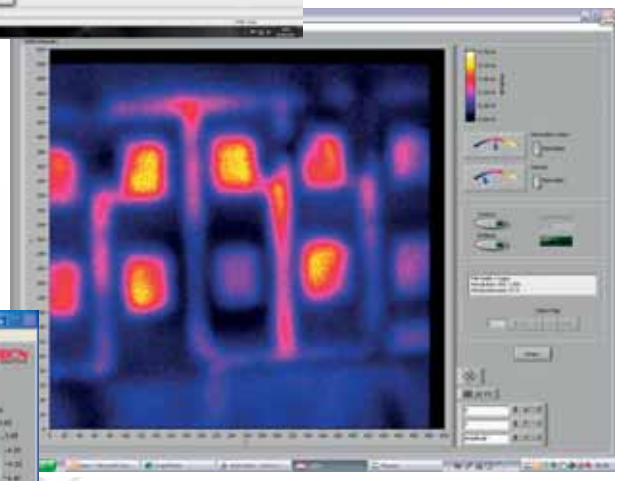
DN100 fitting with off-axis collection and parallel plate energy filter.

MASsoft and ESM

Instrument control is provided by the MASsoft software suite. The process flow is shown graphically and can be configured to permit simple click and measure one button analysis for basic applications, through to the creation of complex experiments with independent control of most instrument parameters. Electronic gating allows rejection of crater edge effects and the optional Elemental SIMS Mapping suite is used to collect mass resolved images. Data are available in ASCII format for direct transfer to external processing packages and can even be exported using copy and paste commands during analysis.



MASsoft experiment control.



ESM – image of aluminium bond pad layout.

Ion gun control software.

The ion gun control software permits saving and retrieval of gun settings enabling swift and accurate changing of parameters, for example, from a high current large spot for cleaning, to a fine focus, low current, probe for imaging. The software constantly monitors the gun power supplies and alerts the user if a problem is encountered. Controlled ramp rates protect sensitive components such as the caesium ion source.

HIDEN ANALYTICAL

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