HIGH PERFORMANCE SIMS

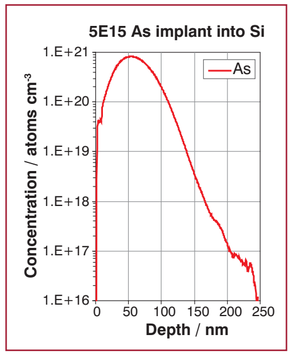
MASS AND ENERGY ANALYSER FOR SIMS

INTRODUCTION

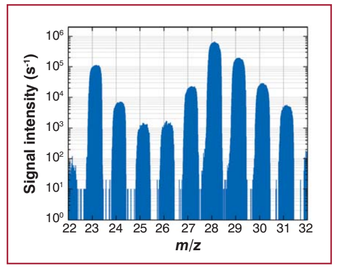
Secondary Ion Mass Spectrometry is the most sensitive surface analysis technique with detection limits for many elements in the ppb range. Samples are bombarded by an ion beam under ultra-high vacuum conditions and the sputtered material, characteristic of the surface, is detected by mass spectrometry.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

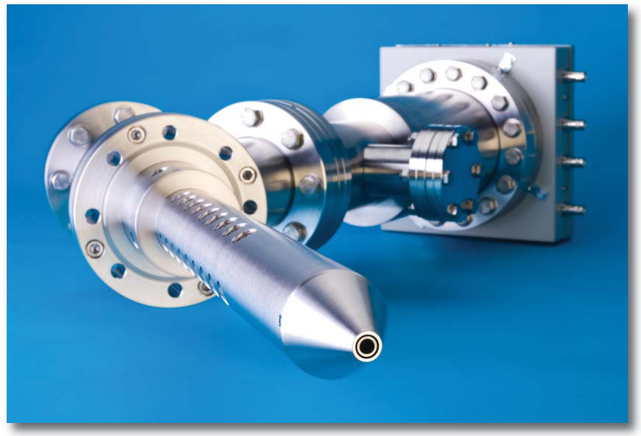
APPLICATION



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 5 keV Cs^+ primary ions from the IG5C whilst collecting $AsSi^-$ secondary ions.



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



EQS SIMS Analyser is mass and energy resolving with high sensitivity collection optics suitable for general purpose SIMS, surface science and focussed ion beam SIMS (FIB-SIMS) applications. It features DN63 fitting with on-axis collection and a 45° electrostatic sector energy filter. Customised lengths are available.

OPERATION

1. **Ion Extraction Optics:** The screened extraction system provides high collection efficiency over a wide angular range and is suitable for both grounded and biased target systems.
2. **Electron Impact (EI) Ion Source:** In EI mode the dual filament electron impact ion source is used to create ions from the neutral species which diffuse into the ion source. The electron emission current is the current collected by the ion source cage, this is measured and used to stabilise the filament current. The electron energy is user controlled, enabling the ionisation energy to be used to preselect neutral species for analysis.
3. **Transfer Ion Optics:** A drift space and lens are used to transfer the ions to the input of the energy filter. In this drift space ions are accelerated to a higher kinetic energy. A lens is used to match the ion into the energy filter.
4. **Quadrupole Lens:** Optimises the beam geometry for injection into the energy filter.
5. **Energy Filter:** The energy filter is a 45° sector field electrostatic energy analyser fitted with fringe field correction apertures. The analyser radius is 75 mm providing high resolution and transmission. Energy pass band is 0.5 eV with 100 % transmission within pass band.
6. **Decelerating Lens:** A decelerating lens reduces the kinetic energy of the ion beam before injection into the quadrupole mass filter.
7. **Quadrupole Mass Filter:** The quadrupole mass filter is constructed in three sections, prefilter (RF only), main filter (RF and dc) and post filter (RF only). The mass filter resolution is electronically controlled and is software adjustable to allow the user to easily optimise all parameters according to the requirements of the experiment.
8. **Detector:** The detector is an off axis mounted continuous dynode electron multiplier which operates in pulse counting mode. The three variables which control the detector are: (i) the first dynode voltage - this is the voltage on the front of the detector; (ii) the multiplier HT - this is the voltage across the detector; and (iii) a discriminator which is used to set a counting threshold on the pulse output from the multiplier. The pulses from the detector can be electronically gated so that only pulses detected during the gate time are recorded. This is especially important for depth profiling and time resolved surface studies.

PRIMARY ION GUNS

IG5C Caesium Ion Gun

Caesium primary ions are essential for sensitive detection of electronegative elements. The IG5C provides ions up to 5 keV 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 and analysis applications.

Sample Viewing

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

Normal incidence lighting and camera for undistorted view.

Ion Gun Control

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.

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