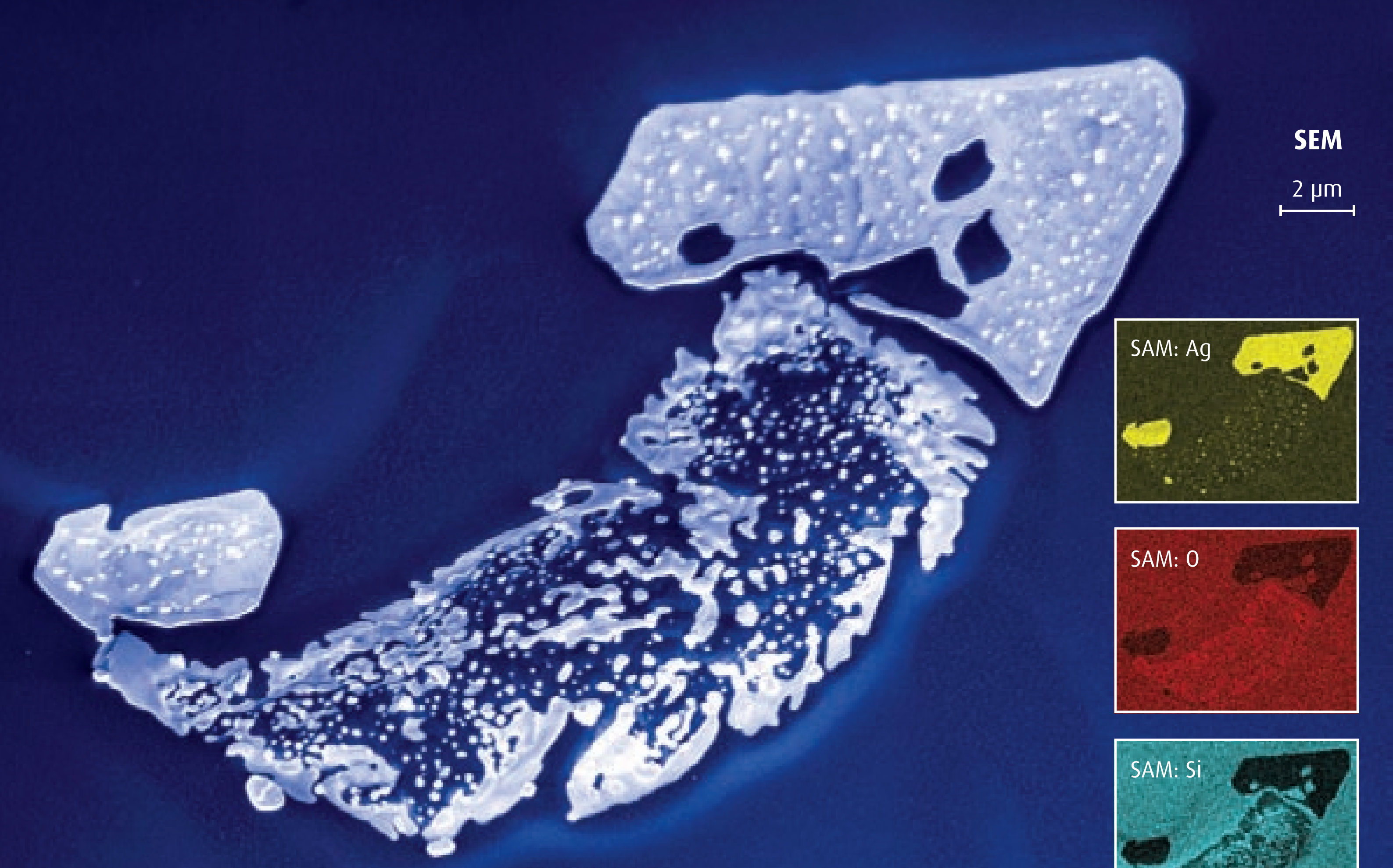
NanoSAM Lab

Scanning Auger with Ultimate Resolution

- 5 nm SAM Resolution
- 3 nm SEM Resolution
- Depth Profiling and Charge Neutralisation
- Additional Techniques: EBSD, SEMPA, FIB, EBL

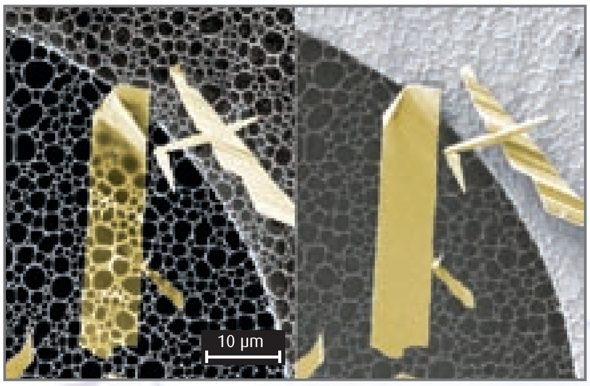


Chemical Analysis with Ultimate Resolution

The NanoSAM Lab is the ultimate tool for the analysis of small structures. Driven by the unique performance of the UHV Gemini electron column, it guarantees unrivalled resolution below 5 nm in Scanning Auger Microscopy (SAM) and better than 3 nm in SEM.

In contrast to other Auger tools, the extremely good resolution is not only available at standard 20 keV beam energy, but even at 5 keV the SAM resolution remains below 10 nm. This allows operation in a parameter range where the Auger cross sections are high, and well documented for quantitative analysis.

The NanoSAM Lab is tailored for the fast and efficient acquisition of data on routine samples, while maintaining the flexibility to operate in untypical parameter ranges on challenging materials. Furthermore, the NanoSAM Lab may be extended with additional techniques for a complementary analysis of the key sample characteristics, for example the crystal structure (EBSD) or the magnetic domain structure (SEMPA).



Coloured SEM images of ultra-thin SiN "sheets" on a TEM sample holder, simultaneously acquired with the UHV Gemini Column with in-lens and external secondary electron detector (left and right). Sample by courtesy of: Dr. T. Sekiguchi et al., Nanomaterials Laboratory, NIMS, Japan.

UHV Gemini Column

The patented UHV Gemini Column is the electron source with the highest resolution available for UHV operation. Designed for true UHV <1x10^{-8} Pa, the column is fully bakeable to 180°C and operates without any measurable outgassing: a must for contamination-free research on many materials.

The design of the UHV Gemini Column is the result of a collaboration between Omicron and ZEISS NTS, employing the same electron optics as used in the ZEISS Gemini SEM product range. Both the leading edge SEM software SmartSEM™ and the Gemini control electronics are standard products from Zeiss NTS, incorporated also in the UHV version.

The Auger control software is integrated with the SmartSEM™ software. For efficient data processing an industry standard software is available. Data can also be saved in standard formats such as VAMAS or ASCII.

NanoSAM Lab with sample preparation chamber.

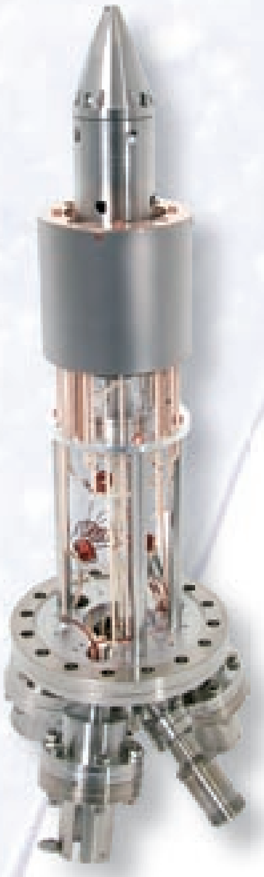
Charge Neutralisation and Depth Profiling

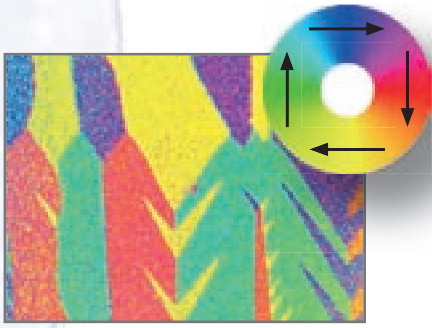
Analysis of insulating materials is often impossible with AES, or at least a challenging task. The FIG 05 sputter source enables the operator to compensate negative charges induced by the electron beam with a flood of low-energetic positive ions. This allows analysis of samples which could otherwise not be imaged under stable conditions.
The FIG 05 may also be used for depth profiling with a beam energy ranging from a few 100 eV on delicate samples to 5 keV with high current density for rapid profiling.

Optional Techniques

- Combined XPS and SAM for in-situ analysis of the elemental composition and chemical functionality.
- Electron BackScatter Diffraction (EBSD) for in-situ analysis of the crystal structure alongside with the elemental composition.
- Focussed Ion Beam (FIB) for tailoring of the sample structure (UHV-Crossbeam with < 10 nm spot size).
- SEM with Polarisation Analysis (SEMPA) for imaging of the magnetic domain structure.
- Electron Beam Lithography (EBL) under cleanest conditions (UHV < $1*10^{-9}$ Pa) for basic research on new resists materials and smallest structures (also for Electron Beam Induced Deposition (EBID)).

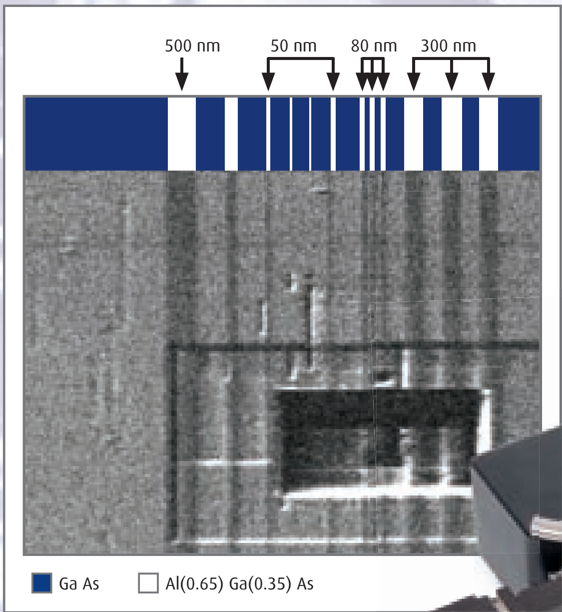
For information about the combination of SEM/SAM with SPM and 4-point probers please request our MULTISCAN Lab and UHV NANOPROBE brochures.



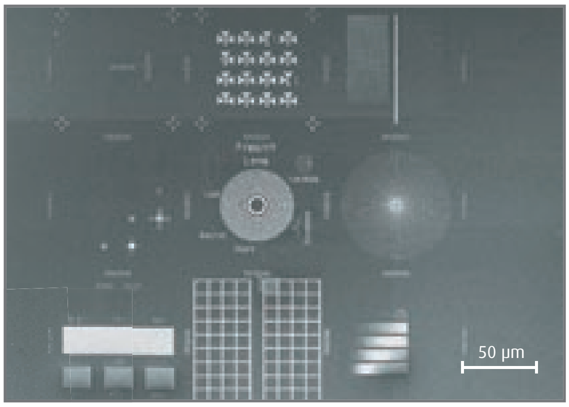


SEMPA: Image of the magnetic domains of an iron whisker with a typical "fir tree" structure. Each colour indicates a different direction of the magnetisation (4 different domain orientations).

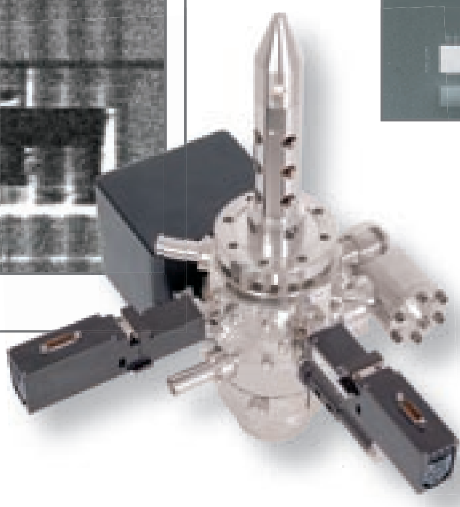
Left: SEMPA detector.



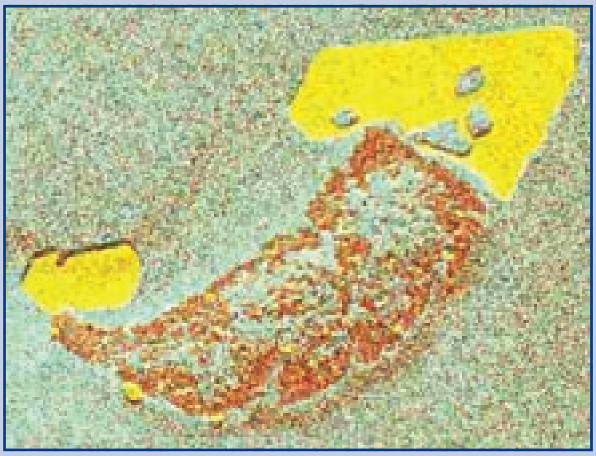
Points, lines and rectangles written with the FIB into a GaAs/AlGaAs heterostructure. Ion-beam-induced secondary electron image.



EBL: Test pattern written with the UHV Gemini Column and the Raith ELPHY software.



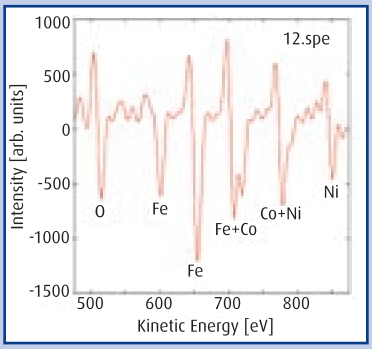
FIB: UHV-compatible 30 kV Ga+ ion beam source.

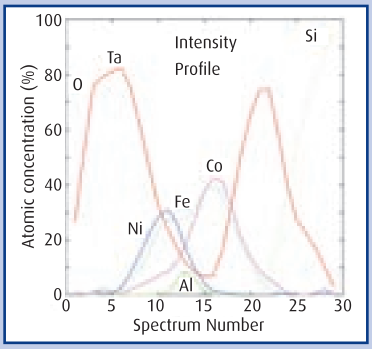


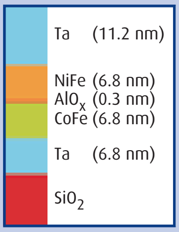
Compositional image showing the distribution of silver (yellow), oxygen (red), and silicon (blue).

NanoSAM Lab at a Glance:

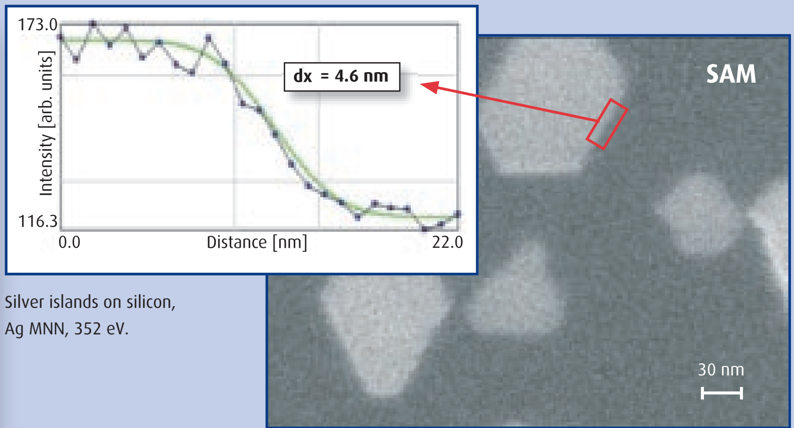
- **UHV Gemini Electron Column:**
  - **- highest spatial resolution**
  - **- smallest e-beam spot size**
  - **- unique low-energy performance**
  - **- efficient SEM with in-lens SED**
- **NanoSAM Electron Analyser:**
  - **- variable energy resolution**
  - **- excellent sensitivity, multichannel detection**
- **Sample Handling:**
  - **- flexible sample size**
  - **- variable sample temperature (50-500K)**
  - **- sample tilt ±60°**



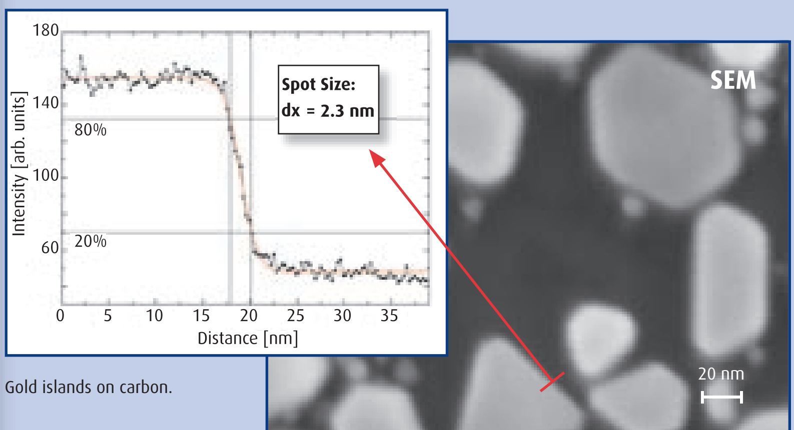




Sputter depth profiling experiment on a magnetic tunnel junction. The schematic shows the theoretical structure with 2 magnetic layers (NiFe and CoFe) separated by a thin insulating AlO$_x$ film. Note that the layer thickness is in the range of the electron mean free path. Nevertheless the different layers are clearly visible, including the extremely thin AlO$_x$ monolayer.



Silver islands on silicon, Ag MNN, 352 eV.



Gold islands on carbon.

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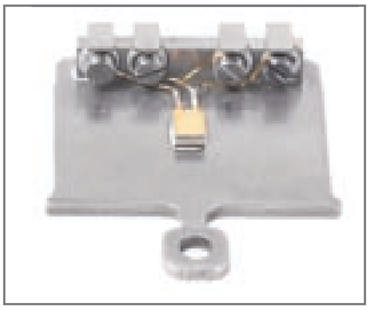

Sample plate with four contacts.

4-axis sample stage with temperature range <50 K up to >500 K. Motorised, precise sample movement (X/Y ± 5 mm, Z ± 3 mm) with optional position read-out, tilt range ± 60°. Sample dimensions typically 10 x 10 x 5 mm^3, larger on request.

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