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Australian
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THE UNIVERSITY OF
WESTERN AUSTRALIA
Achieving International Excellence

Flagships: Cameca IMS 1280 and NanoSIMS 50 Ion Microprobes

Ion microprobes for chemical and high-precision isotopic analysis and imaging to the nanometre scale

This secondary ion mass spectrometry facility offers high-sensitivity and high-precision isotope-ratio analysis in a diverse array of materials.

Scientific Drivers

For decades, secondary ion mass spectrometry (SIMS) has been the tool of choice for measuring trace elements in minerals and semiconductor materials, due to its high sensitivity and its ability to analyse all the elements in the periodic table. Traditional SIMS, however, has been limited by the spatial resolution of the ion beam (generally tens of micrometres), and poor external precision. The two instruments that make up this facility complement each other in transcending these limitations.

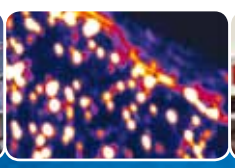
The novel design of the Cameca NanoSIMS 50 allows the primary ion beam to be focused to a very fine probe (50 nm for Cs^+, and 200 nm for O^-), while the ability to scan the primary beam allows secondary-ion images to be obtained at high sensitivity and high spatial resolution. This versatile instrument has reduced the spatial scale of SIMS analyses in the fields of biological, geochemical and materials sciences.

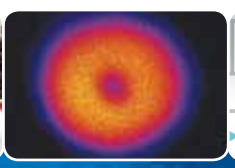
The strength of the Cameca IMS 1280 Ion Microprobe lies in the acquisition of in-situ, high-precision measurements of isotope ratios. This instrument uses a large-radius, double-focusing architecture to provide high sensitivity and high mass resolution simultaneously from spot sizes of less than 20 micrometres.

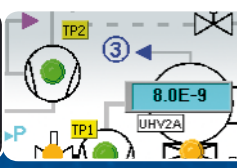
New design features and software tools combine to provide external precision for isotope-ratio analyses of better than 0.02 % for favorable cases. Additionally, the primary ion beam may be focused to less than one micrometre for ion imaging and isotopic measurement of small grains.

Examples of the type of analyses provided by these instruments include:

- Major- and trace-element mapping at the sub-micrometre scale in a wide range of solid materials, including metals, minerals, semiconductors, polymers and biological materials. Sub parts-per-thousand precision for isotopic measurements in solid materials (e.g. $\delta^{18}O$ in zircon, $\delta^{34}S$ in pyrite).
- High-precision elemental ratios (e.g. Mg/Ca in biominerals).
- Automated particle searching and single-particle analysis for forensic and atmospheric chemistry studies.
- Automated analyses for high throughput.
- Chemical and isotopic imaging of biological materials at the sub-cellular scale.
- Imaging of microbial communities or cultured cells by using fluorescent or halogenated DNA probes and isotopic labels.







Capabilities and the National Research Capacity

This facility is the only one of its type in the world to house both these state-of-the-art instruments. The AMMRF is proud to offer this unique analytical capability.

The NanoSIMS is an ion microprobe for ultra-fine feature imaging and analysis, while the IMS 1280 is for in-situ high-precision isotope-ratio analysis. Both are equipped with Cs^+ and O^- primary ion sources, and can detect up to five ionic species simultaneously. Charge compensation for non-conducting samples is achieved with an electron gun, and oxygen flood can be used to improve positive-ion yield.

The SIMS facility is situated in the Centre for Microscopy, Characterisation and Analysis (CMCA), alongside other imaging and analytical instrumentation (TEM, SEM, EPMA, confocal microscopy), and is supported by expert academic and technical staff. Multi-function sample holders are available that allow the same sample to be analysed by TEM, NanoSIMS and IMS 1280.

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