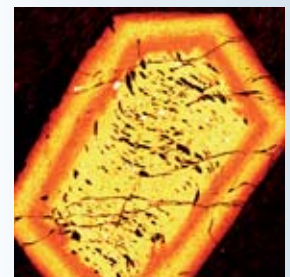
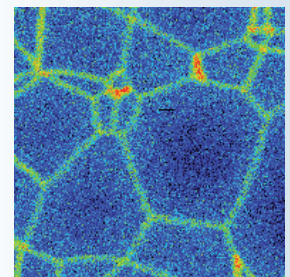




# From Scientific Instruments for Research to Metrology Tools for Semiconductors

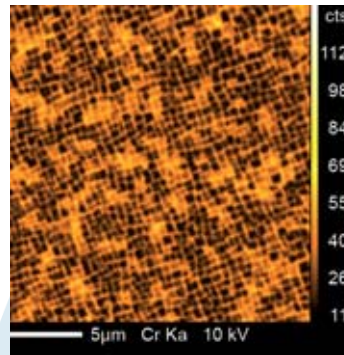


# A wide range of applications...

CAMECA's scientific instruments measure and image the elemental composition (such as copper, oxygen, hydrogen, silicon, etc...) and isotopic composition (such as  $^{235}\text{U}$  /  $^{238}\text{U}$  in uranium) at the surface of solid objects. Very small amounts (micro- or nano-volumes) of material are measured using electrons, ions, or X-rays, instead of using visible light (photons) as in classical optical microscopy.

Applications for CAMECA instruments are very diverse. High technology manufacturers of semiconductors use the CAMECA instruments for their research on novel materials and devices as well as for automated in-line process control. CAMECA instruments are also used at the most prestigious academic laboratories for basic research, in fields such as earth and planetary sciences, materials and nuclear sciences, environmental sciences, cell biology, and microbiology.

The analyses performed by CAMECA instruments are extremely sensitive, measured at ppb levels (parts per billion, that is, one detected atom among one billion surrounding atoms). The analyses are also very localized, ranging from a few cubic micrometers down to a single atom, depending on the CAMECA instrument and the analysis technique. The instruments can display measurement results as element or isotope concentrations in a given volume, elemental or isotope lateral distribution and depth profiles (2-dimensional images and graphs), or 3-dimensional (volume) images.



## Material Science: Metals

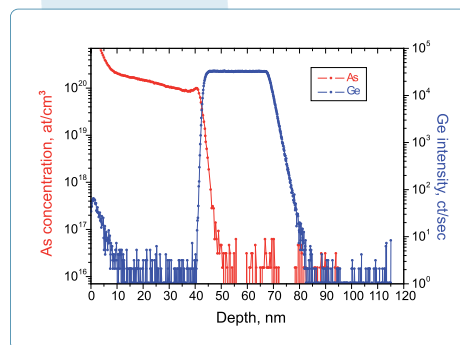
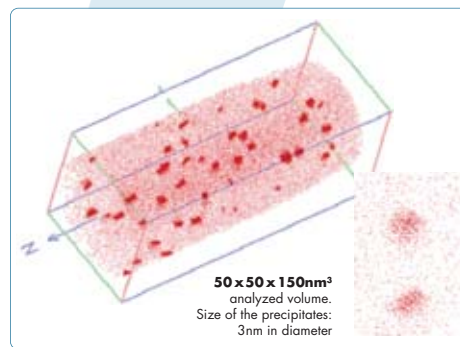
X-Ray imaging of chromium at high spatial resolution on a single crystal nickel-based superalloy. Recorded on the Field Emission Electron Probe MicroAnalyzer (FEG EPMA) model SXFiveFE.

Courtesy of Dr.-Ing. I. Lopez-Galilea, Ruhr-Universität Bochum.

## Materials: Nuclear Science

Precipitation of copper enriched particles under irradiation from a Fe Cu alloy. Each dot shows the position of an individual copper atom in the probed volume. Particles are less than 2nm in diameter and have a number density of  $5 \times 10^{17} \text{cm}^{-3}$ . Data recorded with the 3D Atom Probe.

Courtesy of P. Pareige et al, University of Rouen, France.



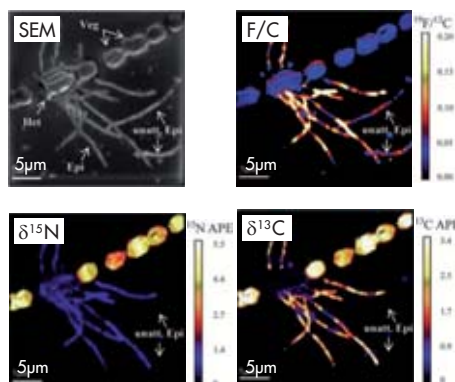
## Semiconductor Manufacturing

Quantitative measurement of the distribution depth of arsenic and germanium dopants inside a SiGe epitaxial layer. Trace element depth profile recorded with the IMS Wf Secondary Ion Mass Spectrometer (SIMS) using High Mass Resolution settings ( $M/\Delta M = 10,000$ ) combined with high depth resolution ( $C_s @ 500 \text{ eV}$ ).

## Microbiology

Coupling a strategy of fluorescence microscopy with stable isotope labeling (i.e.  $^{13}\text{C}$ ,  $^{15}\text{N}$ ), it is possible to determine the phylogenetic identity of uncultivated single microbes and their metabolic activity in one acquisition. Data recorded with the SIMS ion microprobe NanoSIMS 50.

From Applied and Environmental Microbiology, May 2008, S. Behrens et al.



# APT

## Atom Probe Tomography

### LEAP 4000

#### Local Electrode Atom Probe

The **LEAP 4000** Atom Probe is a unique 3D imaging mass spectrometer measuring, quantitatively, the elemental composition of samples with near-atomic resolution. Based on the unique **Local Electrode** concept, it offers **high analysis throughput** and **large field of view**. The tightly focused UV-laser ensures optimized atom evaporation conditions. The **multiple tip design** and a range of accessories ensure high tool efficiency.

Available in two basic configurations, HR and Si. The LEAP 4000 HR is a voltage pulsing only instrument. The LEAP 4000 X HR and LEAP 4000 X Si have ultra small spot UV laser pulsing as well as voltage pulsing capability.

The **LEAP Si** provides fast time to knowledge for microelectronics professionals.

The **LEAP HR** offers high mass resolution even in HV pulsing mode while maintaining a wide field of view. It is ideal for metals and advanced materials applications requiring high mass differentiation and flexibility.



# EPMA

## Electron Probe MicroAnalyzer

### SXFive / SXFiveFE

CAMECA's fifth generation EPMA, now with Field Emission Source.

Available in 2 configurations, **SXFive** and **SXFiveFE**, our new EPMA delivers highest-quality trace and minor element analysis for a wide range of materials and geoscience applications. Precise, qualitative and **quantitative measurement and mapping of elemental composition** with a new, versatile column compatible with W, LaB<sub>6</sub> (SXFive configuration), and FE electron sources (SXFiveFE) for ultimate spatial resolution performance. Fully digital instrument with integrated electronics, entirely automated for **unattended analysis**. The **precision and reliability of its WDS analyzers**, along with the extreme stability of the primary beam, ensure long term, high precision measurements.

Also available, a fully customizable **shielded version** for radioactive sample analysis.



# LEXES

## Low energy Electron induced X-ray Emission Spectrometry

### Shallow Probe EX-300

#### Semiconductor Fab Compositional Metrology Tool

Used for in-fab semiconductor metrology and R&D on thin films (from a few Å to several hundred nm). Based on a non-destructive technique, the Shallow Probe **EX-300** provides **elemental composition and thickness, dopant dosimetry, wafer mapping and micro-mapping** and is designed to accelerate the time to market of advanced logic & memory devices while achieving high production yield.

Targeted for new challenging processes such as **SiGe** and **HKMG** at **32nm node and beyond**, applications also include the monitoring of low energy, high concentration implants, SiON, GST...

CAMECA's **EX-300** offers full in-line production capabilities: pattern recognition down to 30 by 30µm pads, 300mm load ports, automated system based on SEMI standards, throughput varying from 4 to 8 wafers per hour.



## IMS 7f

### Universal Magnetic Sector SIMS

Used in semiconductor R&D, materials and nuclear sciences as well as environmental applications. Provides high-sensitivity **trace element depth profiling and secondary ion microscopy** imaging (2 & 3D). High mass resolution and high transmission capabilities eliminate the numerous interfering ions, allowing the **IMS 7f** to perform true elemental and isotopic analyses with **detection limits down to the ppb level**. High throughput and consistent reliability make it the workhorse of many analytical laboratories around the world.

The **IMS 7f-GEO** is optimized for geoscience applications: stable isotope ratio measurements with sub-permil precision and high throughput.

The **IMS 7fR** is a shielded version for radioactive sample analysis.



## IMS Wf / SC Ultra

### Full Wafer & EXLIE Magnetic Sector SIMS

Used in semiconductor development and manufacturing, optimized for **ultra shallow depth profiling**. These tools specialize in sample sputtering at **EXtreme Low Impact Energy** without compromising the high detection sensitivity of the CAMECA magnetic sector analyzers.

The **IMS Wf** can analyze **full 300mm wafers** and has a pattern recognition system. This metrology tool can be equipped with 300mm FOUP or 200mm SMIF pods and be operated remotely for use in the fab. Thanks to its high level of automation, it performs fast deep depth profiling with optimized sample throughput and excellent measurement stability, ensuring unequalled SIMS tool productivity.

The laboratory version, the **SC Ultra**, has manual sample loading. Computer automation controlling all analytical parameters (analysis recipe, instrument set-up...)



## SIMS 4550

### Universal Quadrupole SIMS

Benchmark quadrupole SIMS with optimized performance in **semiconductor depth profiling, thin layer and insulator analysis**. Its unique FLIG™ technology (oxygen and cesium Floating Low-energy Ion Gun) ensures **high depth resolution** analyses.

The **SIMS 4550** offers:

- total flexibility in sputter conditions (primary ion angle of incidence, energy, species), low extraction field
- low energy electron flood gun, unique OCE (Optical Conductivity Enhancement) for SiGe analysis
- sample holders accommodating a variety of samples: small pieces of a few mm<sup>2</sup> up to 100mm diameter sample size
- easy operation, benchmark **automation** and **reproducibility** for metrology.





## NanoSIMS 50/50L

### High Resolution Ion Microprobe

Unique SIMS instrument **optimized for lateral resolution** while keeping **high sensitivity at high mass resolution** for trace element and isotope analysis. The **simultaneous detection** of up to five species (**NS50**) or seven species (**NS50L**) is possible with EM detectors for imaging or Faraday Cups for high precision isotopic measurements.

The **NanoSIMS** is used in material sciences, geology, cosmochemistry, environmental microbiology and cell biology.



## IMS 1280-HR

### Ultra High Sensitivity Magnetic Sector SIMS

Used in geosciences, optimized for in-situ, localized **trace element and isotope analysis of minerals** with high sensitivity and **sub-permil external reproducibility**. The increased instrument size and optimized optics ensure full transmission at the high mass resolution required to remove the numerous mass interferences present in geologic materials. Five moveable detectors (Electron Multipliers or Faraday Cups) allow the instrument to perform fast, high precision isotope ratio analyses from lithium to uranium, in a **multicollection mode**.

The **IMS 1280-HR** is the state-of-the-art instrument for stable isotope, U-Pb geochronology, trace element and nuclear particle analyses.

## Worldwide Service & Customer Support

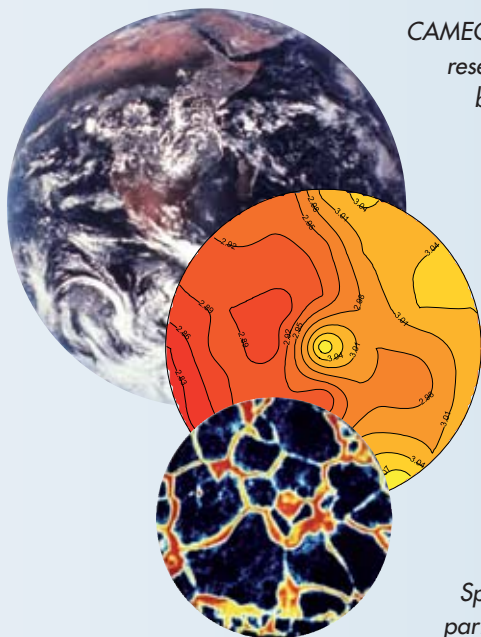
CAMECA provides unparalleled support for our scientific instruments and metrology tools, whether in research laboratories or in semiconductor production lines. To serve customers at the level required by these demanding environments, CAMECA has developed a worldwide customer support organization in China, Germany, India, Japan, Korea, Taiwan, UK and USA. In other parts of the world, users are supported by a network of CAMECA agents.

CAMECA's Field Service Engineers are specialists who offer the highest level of support to CAMECA customers. Each service engineer is certified through advanced training at our factories. In addition, e-mail hot-lines allow customers to receive information directly from specialists at our factories.

To help customers make the most efficient use of their instruments, CAMECA offers various types of training, ranging from general operation to solving specific scientific problems. Training can be given on-site or at our factories.

Our high quality products along with an expansive support network result in many years of dependable, high-performance operation. Upgrades offer users the benefits of the latest improvements maintaining high levels of instrument performance.

Spare parts inventories are maintained at our factories and subsidiaries, ensuring that next-day parts deliveries are available via overnight shipment.



# The Company behind the Products...

From its inception, CAMECA\* has been renowned for its precision mechanics, optics and electronics. In 1929, CAMECA started in France as a manufacturer of movie theater projectors. From that beginning, CAMECA products evolved into scientific instrumentation.

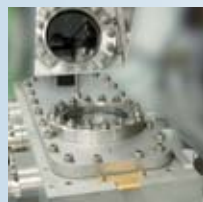
(\*from "Compagnie pour les Applications Mécaniques à l'Electronique, au Cinéma et à l'Atomistique").

In 2007, CAMECA joined **AMETEK Inc.**, a leading global provider of electronic instruments and electromechanical devices, as part of the **AMETEK Materials Analysis Division**.

With more than a thousand instruments installed worldwide, CAMECA is the **recognized world leader** in the techniques of **Secondary Ion Mass Spectrometry (SIMS)**, **Electron Probe MicroAnalysis (EPMA)**, **Low energy Electron induced X-ray Emission Spectrometry (LEXES)**, and **Atom Probe Tomography (APT)**. We are intently focused on instrumental development that offers the highest technical performance in specialized characterization fields. We collaborate with major academic institutions to develop new techniques and to stay on the cutting edge of emerging technologies.

Under ISO 9001 certification, CAMECA controls not only the technology, but all aspects in the designing, manufacturing, installing and servicing of our products. Located at our headquarters near Paris, France, as well as at our newly established Atom Probe Technology Center in Madison, Wisconsin, USA, our plants are state of the art facilities, using the best practices for clean room production, computer networking, electron and ion optics simulation and advanced CAD.

Headquartered near Paris, CAMECA has offices in UK, Germany, Japan, Korea, Taiwan, China, India and USA. A network of agents handles sales and support for the rest of the world.



For in-depth product information,  
application examples...  
visit the CAMECA web site:  
[www.cameca.com](http://www.cameca.com)



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