CAMECA SCIENCE & METROLOGY SOLUTIONS — World Leader in Micro & Nano Analysis

AMETEK MATERIALS ANALYSIS DIVISION

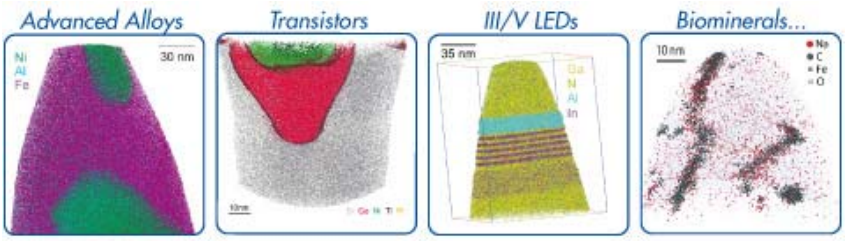
CAMECA e-newsletter - October 2015

Welcome to the 12th edition of the CAMECA e-newsletter!

It is our pleasure to once more bring you the latest news on instrumental and software developements at CAMECA, and to report on innovative industrial applications and research projects supported by our SIMS, EPMA, LEXES and Atom Probe Instruments. Feel free to request any of the application notes or articles mentioned below, or to ask your local sales representative for more information!

Atom Probe Tomography (APT)

CAMECA 3D ATOM PROBES: PROVIDING NANOSCALE COMPOSITIONAL ANALYSES FOR ALL TYPES OF MATERIALS AND A WIDE RANGE OF APPLICATIONS



LEAP Atom Probes are the only instruments delivering 3D compositional imaging and analysis with near-atomic resolution, ppm sensitivity and high throughput. From steels and alloys to complex minerals or the most sophisticaded nanotechnolology materials, today's most critical research fields are all covered by Atom Probe Tomography!

Request the full set of LEAP application notes to learn how APT can assist you in your field of research. The following application notes may also be downloaded directly from cameca.com:

- Carbon segregation in steels with LEAP & STEM
- Grain boundary analysis in Ni-based Super Alloy 600
- Grain boundary analysis in ultrafine grained light alloy
- Nuclear: Nanoscale features providing radiation damage resistance
- Geology: Analysis of a 4.4 billion year old zircon
- Semiconductor - 3D analysis of a 28nm node S/D region
- LED device engineering - A case study in competitive analysis
- Optical fiber - Analysis of dielectric nanoparticles
- Optoelectronics - Dopant distribution in ALD-grown ZnO
- Synergistic t-EBSD/TDK & APT grain boundary analysis

LIVE FROM CURTIN UNIVERSITY, AUSTRALIA: THE FIRST "GEO" ATOM PROBE STARTS ANALYZING SAMPLES FROM THE DEEP EARTH AND FROM OUTER SPACE

Installed a few weeks ago at the John de Laeter Center, Curtin University, Australia, the Curtin LEAP is **the first Atom Probe instrument in the world dedicated to geosciences!**
Already at the forefront of high-impact R&D in minerals and energy sectors, Curtin University is recognized for its research in Earth Sciences. Scientists at Curtin can now benefit from a revolutionary microscope allowing them to obtain a three-dimensional picture of elemental distribution in nanoscale volumes of natural ore deposits, meteorites and other mineral samples. Planned projects include: element mobility in accessory minerals during tectonic and impact-related deformation, distribution of precious metals in gangue minerals, and the study of extra-terrestrial materials to understand element distributions during various stages of solar system evolution.
The Geoscience Atom Probe is part of the new **Advanced Resource Characterisation Facility (ARCF)**, a partnership between Curtin University, The University of Western Australia and Australia's national science agency CSIRO. ARCF draws together state-of-the-art equipment for geoscience and resource characterization, including a CAMECA NanoSIMS.

CAMECA LEAP: GROWING SUCCESS IN INDUSTRY & ACADEMIA!

Over the past months, our LEAP Atom Probes have had growing success in both industry and academia all around the world.

In the US, **Nanolab Technologies**, a Silicon Valley analytical service company recently chose CAMECA's Atom Probe technology to enhance their strategy of providing the most advanced, ultra high resolution analytical solutions to their customers consisting of top-ranking semiconductor OEMs and fabricators. **APT is now set to play a key role in the R&D and failure analysis of novel microelectronics device!**

In Europe, our new generation Atom Probe, the **LEAP 5000**, was recently installed at Max Planck Institute for Iron Research, Dusseldorf, Germany. Installation will follow at Belgium's KU Leuven Universit, and at University of Oxford's Department of Materials.

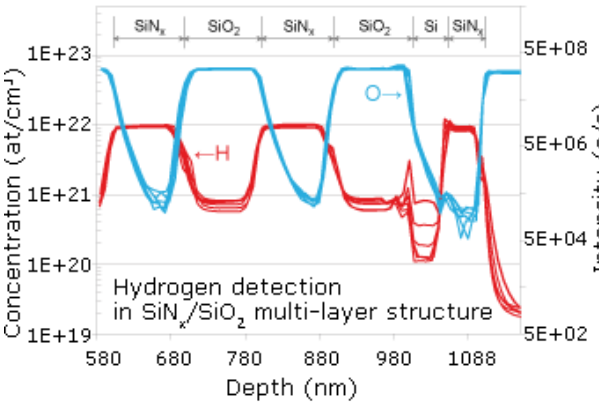
In Asia, University of Science & Technology Beijing and City University of Hong Kong both ordered a LEAP 5000 model which they will apply to the development of advanced materials such as high strength steels, metallic glasses, nanomaterials.

For more information on the **LEAP 5000's new features** go to this link or request the new LEAP 5000 brochure.

SIMS & NanoSIMS

IMS 7f-Auto: SUPPORTING R&D OF LED LIGHTING & DISPLAY DEVICES

The optimization of LED devices and electroluminescent thin-film structures requires information on low-level impurities (H, C, O, N...) for a better understanding of device lifetime and failure modes. While common microanalytical techniques fail to measure these atmospheric species, the **IMS 7f-Auto** Dynamic SIMS tool achieves ppm level detection limits and excellent reproducibility at high throughput on H, C, O and N **light elements** in complex LED and display structures.

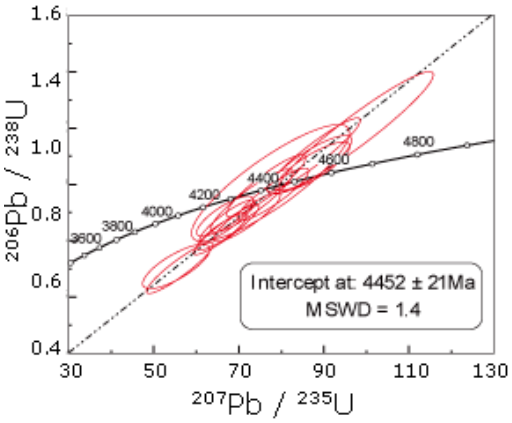


Shown here is the in-depth distribution of hydrogren in a multi-layered display structure.
Six samples prepared under different process conditions (annealing, de-hydrogenation, hydrogenation) were analyzed in order to investigate how the process affects the hydrogen content in the Si layer.

For more information, **request our new application note** "Analysis of light elements with benchmark detection limits and high throughput - Applications in Semiconductor, PV, LED, Display, Metallurgy & Nuclear Science".

IMS 1280-HR: ADDRESSING A WIDE RANGE OF U-Pb GEOCHRONOLOGY APPLICATIONS

Hundreds of scientific papers on **U-Th-Pb geochronology** have been published based on data obtained with CAMECA Ultra High Sensitivity SIMS (IMS 1270/1280/1280-HR). Not only zircon, but also monazite, apatite, titanite, rutile and baddeleyite are all accurately dated by our **IMS 1280-HR** series instruments.
In the below study, in situ U-Pb dating analyses were performed on apatite from the Chelyabinsk meteorite. Precise age determination of apatite from meteorites is challenging due to the very low uranium abundance (<10 ppm). Using optimized instrumental conditions combining high transmission and high mass resolution, the grains were dated with excellent precision and accuracy.



Concordia plot for Chelyabinsk apatite grains.

The upper intercept age is 4,452±21 Ma, much younger than the majority of other ordinary chondrites phosphate ages.

Data from O. P. Popova et al, Science 342 (2013) p. 1069.

To learn more, **request our new application note** "Advanced U-Th-Pb Geochronology with CAMECA Ultra High Sensitivity SIMS" or visit www.cameca.com.

NANOSIMS 50L: CONFIRMING EXCELLENT RESULTS WITH NEW RF-PLASMA O- PRIMARY ION SOURCE

The **NanoSIMS 50L** is renowned for its exquisite element/isotope sensitivity at high spatial resolution (50nm) *and* high mass resolution. Up to now most analyses have been performed using Cs+ primary ions and detecting negative secondary ions. This was due to the lower brightness of the duoplasmatron source in O- mode compared to the cesium source, leading to practical beam size of 200-300nm in O-.
Following the path of the IMS Wf/SC Ultra already using a RF plasma O2+ primary ion source for extremely low impact energy SIMS depth profiling, CAMECA recently

CAMECA SIMS: SUPPORTING TOP-TEN SEMICONDUCTOR COMPANIES

Recent sales successes of our magnetic sector SIMS (IMS 7f-Auto, IMS Wf as well as NanoSIMS 50L) with top ten semiconductor companies in Asia and the US have further consolidated our position as a leading provider of high-end nanoanalysis solutions for a wide range of semiconductor applications: power electronics device development, implant dose monitoring and thin film concentration investigation in microelectronics, LED & display technology, etc...

In addition to these key industry players, several materials analysis laboratories rely on CAMECA technology for their services to the semiconductor industry. Among them, the Taiwanese MA-tek, a long time user of CAMECA SIMS, selected our IMS 7f-Auto to further support their service activities in front-end semiconductors, III-V and solar cell device development.

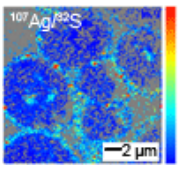
A SUCCESSFUL SIMS XX CONFERENCE

CAMECA was Platinum sponsor of the XXth International Conference on SIMS held in Seattle Sep. 13-18. Many thanks again to all our users, customers and partners who visited our booth and attended the CAMECA reception.

Our product managers presented recent instrumental developments and application data with our magnetic sector SIMS, among which:
- Light Elements Measurements using the CAMECA IMS 7f-Auto
- Assessment of Accurate Analysis in Low Dimensional or Confined SiGe Structures using Low Energy Dynamic SIMS Technique
- Improvements of Isotopic Ratio Reproducibility using EMs on the CAMECA IMS 1280-HR
- Applications of a New O- Ion Source on the NanoSIMS 50L for Subcellular Localisation of Important Elements in Plants

Posters and/or slides will be sent on request!

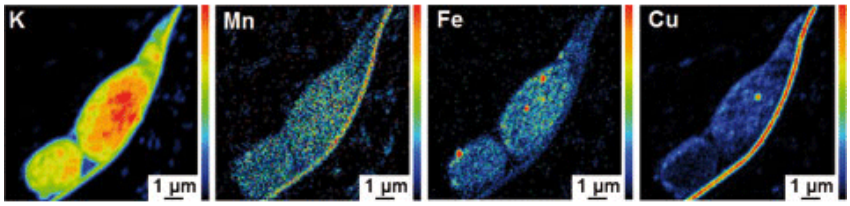
WINIMAGE NEW VERSION 4.2



Specifically developed for CAMECA SIMS instruments, **WinImage** software offers powerful image visualization, processing & printing capabilities in a user-friendly flexible interface.

Among the new features of version 4.2: a file manager (DataExplorer) allowing to quickly locate one image among

integrated a **RF plasma O- ion source** in the NanoSIMS 50L, replacing the duoplasmatron. Three NanoSIMS are already equipped, and we can confidently guarantee the same spatial resolution and beam density in oxygen for electropositive elements as with the cesium source for negative secondary ions. This opens **a wealth of new applications for metals, alkalis, REEs and uranides!**
The new source is field-upgradable on already installed NanoSIMS 50 and 50L. Contact your local sales rep for more info!



Studying the role of (trace) metals involved in photosynthesis:
Subcellular localization of metals in chloroplast of Arabidopsis thaliana leaf cells.
By courtesy of D. Schaumlöffel and J. Malherbe, Univ. of Pau/CNRS/IPREM, France.

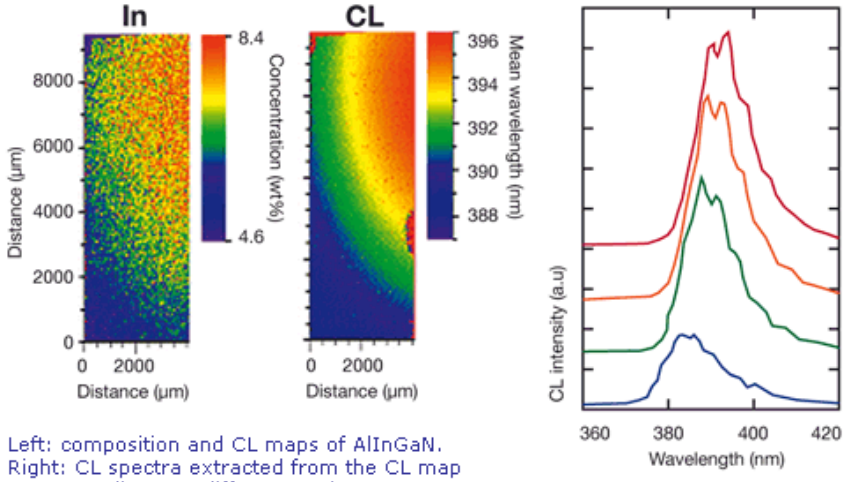
thousands, image pixel addition, automated and multi-parameter ROI definition, improved flexibility for depth profiles reconstruction from (many!) ROIs, export toward Excel and WinCurve, improved drift correction process and easier parallel 3D display. For more information and upgrade options, please contact our sales department.

EPMA: SXFive & SXFiveFE

LED DEVICE OPTIMIZATION WITH CAMECA EPMA

Mainly used in geosciences and metallurgy for quantitative analyses of minor and trace elements at high spatial resolution, the CAMECA SX microprobes are also applied to other materials such as semiconductor and devices such as LEDs. The group of Robert Martin at Strathclyde University in Glasgow dedicates its SX EPMA to understanding **III-V epitaxial materials and devices**.

The combination, in one instrument, of luminescence spectroscopy and x-ray microanalysis in spatially resolved sub-micron spots allows them to track the Indium incorporation in epitaxial AlInGaN layers under different growth conditions.



Left: composition and CL maps of AlInGaN.
Right: CL spectra extracted from the CL map corresponding to 4 differents points.
The luminescence spectra show a strong correlation with the In concentration variation. Data adapted from K. Bejtka et al., Journal of Applied Physics, 104, 073537 (2008).

Using a CAMECA SX microprobe, the Strathclyde Uniersity researchers achieve a better understanding of AlInGaN materials properties, thus optimizing the epitaxial growth process and improving the efficiency of light emitters.

For more information, you may request the full published article by K. Bejtka et al., or read the detailed case study in the newly published EPMA short guide (on request).

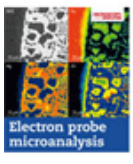
CAMECA SXFIVE: CONFIRMED SUCCESS!

This year again, our **SXFive** and **SXFiveFE** have outsmarted competition on numerous deals, adding to our user base several prestigious academic institutions such as the University of Oxford, as well as key industrial accounts, among which a major player in the automotive industry... These new orders once more demonstrate the huge potential of the CAMECA EPMA technology, and its applicability for shaping tomorrow's breakthrough materials.

PEAKSIGHT NEW V. 6.0

PeakSight 6.0, the latest version of our Automation and Analysis software for CAMECA SX EPMA comes with a completely redesigned interface for improved ease-of-use. A set of new fonctionalities ensures enhanced data acquisition and processing. Among others, PeakSight can now acquire and process LI X ray lines which provide a more accurate quantification of the first series transition metals.
More information at this link. You may also request the EMAS 2015 poster presentation **"Accurate EPMA quantification of the First Series Transition Metals using LI lines"**

EPMA ESSENTIALS



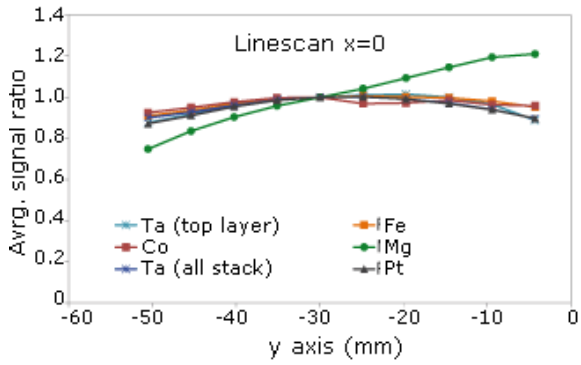
Co-edited with Wiley, this short guide provides a practical introduction to EPMA, insight in the operation of the instrument, case studies... **Request your free copy** (print, pdf or mobile-enabled format).

EX-300 Shallow Probe: Supporting innovation at 14 nm and beyond

EX-300 LEADS THE RACE IN STT-RAM MEMORY METROLOGY, A PROMISING EMERGING NON VOLATIVE MEMORY

Pioneer in the control of embedded layers in ONO-type memory stacks, the **EX-300 Shallow Probe** once again demonstrates unrivalled capabilities to perform **nanometer scale measurements of embedded ultrathin films** used in Spin Torque Transfer RAM (STT-RAM). Composed of several thin film stacks deposited sequentially, the control of layer composition and uniformity is key to device performance. Particularly critical is the MgO layer, whose composition and uniformity have a major impact on the tunneling effect used in MRAM.

Until recently, only electrical characterization on blanket wafers was used to monitor the MgO layer. But it occurs at a very early stage, and thus cannot track potential thin film property evolution along the process chain. Combining patterned wafer compatibility with measurement capability at any of the process steps, CAMECA Shallow Probe technology opens new horizons for monitoring of future high volume STT RAM production.



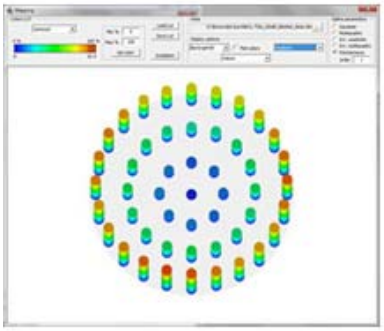
Results from first generation 100 mm samples exhibiting an intentional gradient in order to test metrology sensitivity (data collected with SPINTEC). Shallow Probe demonstrates repeatability better than 0.5% on the Mg signal and is able to track composition variations across the wafer, for MgO as well as for other stack components.

CAMECA Shallow Probe technology is commonly used to develop down to 7nm CMOS processes, it also enables tight control of emerging Non Volatile Memory volume production beside conventional memories. For further details on Shallow Probe usage in memory process, you may request a copy of our Frontiers 2015 (FCMN) conference presentation.

LEXES-Pilot: VERSION 1.7 FOR REAL-TIME DOSE & CONCENTRATION MAPPING

The Shallow Probe has become a standard technology for mapping composition uniformity in blanket and patterned wafers with continuously improved throughput. Because most data are reported to a host computer, fast visualization of data through mapping display helps optimize processes during engineering and ramp-up phases.

LEXES Pilot 1.7 offers new **real-time mapping display capabilities** that provide engineers a quick overview of the wafer profile, without the need for time-consuming off-line data processing.



With LEXES Pilot 1.7, CAMECA reinforces the relevance of Shallow Probe technology for production monitoring.>

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