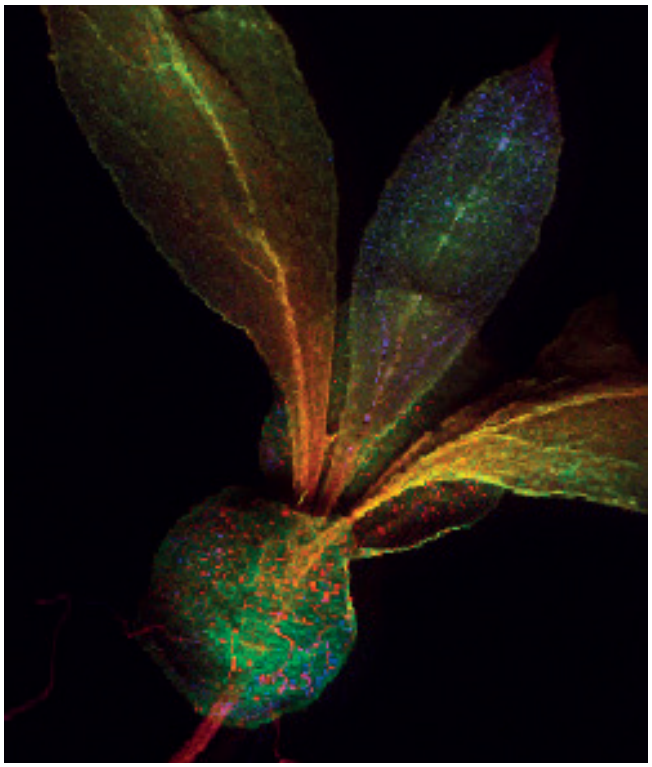
AttoMap™-200
X-ray fluorescence microscope with synchrotron capabilities

Quantitative elemental mapping at micronsscale for contaminants, thin films, mineralogy & metallomics research at sub-ppm sensitivity



Biological application: Hyperaccumulating seedling with elements of interest of K (Blue), Cl (Green), S (Red) shown and trace accumulation of Ni, Mn in roots detected

Sample provided by Dr. Antony van der Ent and Dr. Peter Erskine, The University of Queensland, Australia

AttoMap advantages at a glance

- >1000X sensitivity of SEM-EDS for simultaneously acquiring a range of elements
- Ability to measure thin films and dopants at sub-angstrom sensitivity
- Chemical imaging at <8 µm … and down to 5 ms/point
- Quantitative analysis with standards-based or standardless approaches

Parameter	Specification
Spot size	High resolution (<10 µm)
Sensitivity	Sub-ppm relative detection sensitivity and capable of mapping trace elements. Picogram to femtogram absolute sensitvity (element & acquisition time dependent)
Additional capabilities	Optical microscopy and x-ray transmission microscopy included
Footprint	137 cm x 166 cm x 98 cm (W x H x D)
Maximum sample size	50 cm x 50 cm 15 cm thickness
Source	Sigray high brightness microfocus source
Target material	Dual energy option, includes selection from: Cr, Cu, Rh, W, Mo, etc.
Power | voltage | current	50 W | 20-50 kV | 2 mA
X-ray optic	Sigray twin paraboloidal X-ray optics (matched to each target material)
Transmission efficiency	~80%
Working distance	10 - 50 mm (customizable)
Interior coating	Platinum (increases NA of optic significantly)
X-ray detec tors	SDD detector and an X-ray camera Optional 2nd SDD detector
Energy resolution	<15 eVat Mn-Ka

Sigray AttoMap™ is designed for ultimate flexibility: its modular design enables upgrades with additional techniques and its convertible staging design allows operation both vertically (microXRF mode) and horizontally (beamline mode)

Quantum Design

Quantum Design
1 avenue de l'Atlantique
Bâtiment Fuji-Yama
91940 Les Ulis - France

Tél. : +33 1 69 19 49 49
france@qd-europe.com
www.qd-europe.com

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AttoMap technology for synchrotron performance

1) High brightness x-ray source with 50X brightness of microfocus sources used in conventional microXRFs

50X Brightness: Sigray's ultrahigh brightness x-ray source features an innovative x-ray target comprised of multiple materials in close thermal contact with a diamond substrate.

The breakthrough design allows:

- rapid thermal dissipation through the diamond substrate which allows the x-ray target metals to remain cool under dramatically higher power loading, and
- linear accumulation of x-rays for laser-like brightness.

Multi-Energy Target: X-ray fluorescence is highly dependent on the energy of the illuminating x-ray beam and can vary by several orders of magnitude. Sigray's multi-target source provides easy software-selection of target materials to ensure the ultimate sensitivity for each element. No other microXRF system offers multiple x-ray targets.

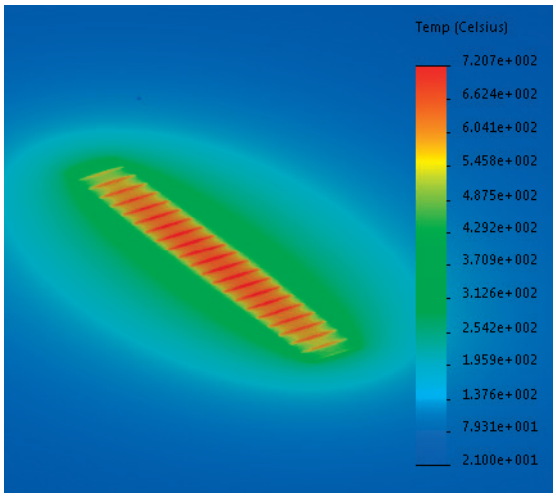
2)Paraboloidal x-ray optics with major advantages over conventional polycapillary microXRF systems

The AttoMap is the only microXRF that uses a double paraboloidal x-ray optic, which Sigray manufactures through the same proprietary fabrication process it uses to create specialty synchrotron optics. Other microXRFs use conventional laboratory x-ray optics, such as polycapillaries (or tapered monocapillaries). The double paraboloidal optic provides major advantages in: resolution, quantitative capabilities, analytical flexibility, and x-ray flux at the sample.

3) Unique detector geometry with 3-4X collection angle than conventional systems

The long working distance and compact form factor of the double paraboloidal x-ray optic enables a unique geometry in which multiple SDD detectors are placed in close proximity to the object to collect 3-4x more fluorescent x-rays for increased analytical speed. Conventional microXRF systems typically place detectors at an offset angle because polycapillary x-ray optics have a well-known "halo effect" that requires an aperture for removal.

The AttoMap also features a transmission x-ray detector for 2D microscopy and an optical microscope.



Thermal benefits of the FAAST Source

Finite element analysis of one configuration of the FAAST source. The target design provides thermal advantages to achieve dramatically higher power loading in comparison to the extended metal targets used in conventional microfocus x-ray sources.

	1.5 (Al K)	3 (Rh L)	8 (Cu K)	11 (Pt L)	17.4 (Mo K)
B	17	2.3	0.06		
N	200	28	1.3		
F	1,270	190	10		
Na	4,400	700	40		
Al		2,000	132		
P		5,000	350		
S		7,700	550		
Cl		11,500	1500		
Ti			4,500		
Fe				7,000	1,200
Cu				12,000	2,500
Zn				15,000	3,500

Advantage of AttoMap™'s dual energy

The table above shows selected fluorescence cross-sections of various elements as a function of x-ray excitation energy due to source target material choice. Note that cross-sections vary significantly depending on x-ray target material. AttoMap™ provides access to new target materials (upon request) and dual target options so that results for each application is optimized.

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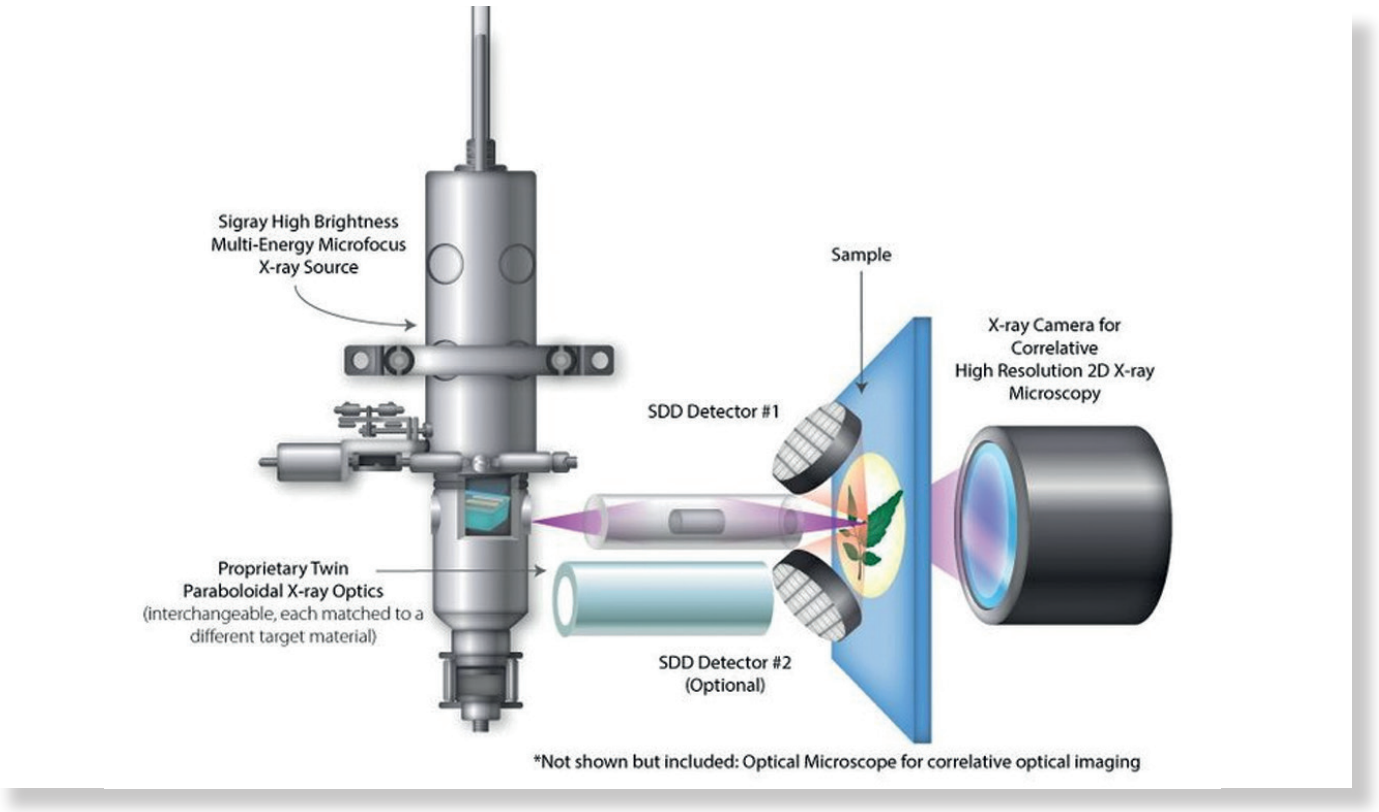
Enabled by patented X-ray technology

Three core new approaches enable the AttoMap's unprecented performance: 1) patented x-ray source featuring an innonvative microstructured x-ray target, 2) proprietary high efficiency x-ray mirror lens, and 3) innovative detector geometry.



How will Sigray help meet your research needs?

Application	AttoMap™ Advantage over other approaches
Semiconductor	Residue from masks (Ni, Co, etc.) between steps with sensitivity down to sub-Angstrom Thickness measurement of high-k dielectrics and other thin layers . Failure analysis of buried failures (e.g. misalignments) and of contamination (non-destructive)
Biology/ Metallomics	Metallomics: mapping and measurement of pathological dysregulation of elements and toxicology Upstream complement to MALDI, LA-ICP-MS, and SIMS on hydrated samples
Batteries & Fuel Cells	Analysis of loose particles and contaminants for industrial processes
Pharmaceutical	Nanoparticle distribution in tissue and cells of nano particles down to 50 nm
Geology	Quantitative mineralogy of trace and rare earth elements for gemstones MLA and OEMSCAN complement with higher sensitivity
Forensics	Gunshot residue, paint chips, trace elements in glass and soil
Materials science	Distribution of elements in alloys (whiskers), glasses, plastic additives, concrete, and more Can be used to analyze samples in situ to observe compositional changes

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Bring Synchrotron XRF capabilities to your lab

Conduct ground-breaking research without needing to apply for beamtime

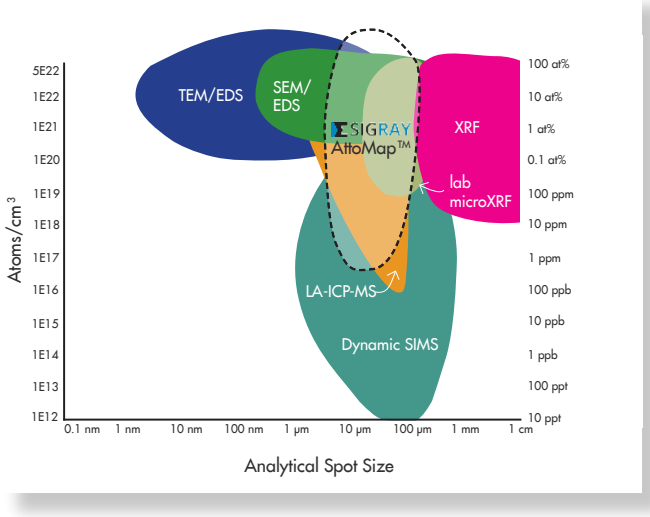
Sigray's AttoMap™ x-ray fluorescence microscope is a breakthrough in lab-based elemental imaging performance, bringing synchrotron capabilities to individual laboratories.

What is fluorescence microscopy?

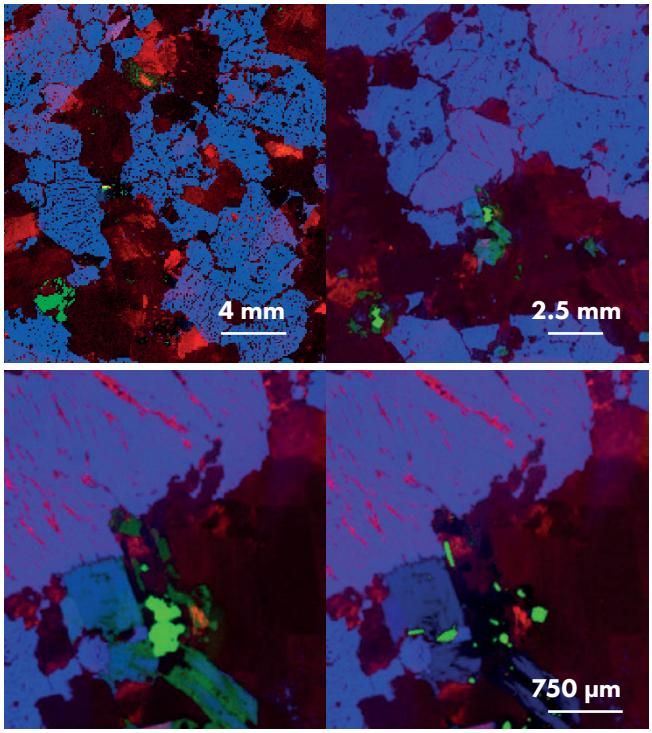
X-ray fluorescence (XRF) microscopy is a powerful spatially-resolved elemental mapping and chemical microanalysis technique originally developed and advanced at x-ray synchrotron sources. The technique uses a microfocused x-ray beam that is rastered across the surface of a sample. These x-rays will excite atoms within the sample and result in the production of characteristic x-rays that can be used to determine the elemental composition of the sample.

Why Sigray's approach?

The AttoMap provides unprecedented sensitivity to detect elements that were previously undetectable with electron-based techniques and conventional microXRF systems. Its performance is enabled by patented innovations: Sigray's ultrahigh brightness multi-energy x-ray source and Sigray's high efficiency double paraboloidal x-ray optics. The instrument provides fast, non-destructive chemical mapping at single digit microns resolution with times down to 5 milliseconds per point.



A powerful new method: The Sigray AttoMap™ is a step change from existing laboratory microXRF capabilities in resolution and detection sensitivity performance, at levels comparable to LA-ICP-MS and with advantages for low atomic number elements and maintaining high sensitivity at small spot sizes.



Elemental mapping of a geological quartz sample at increasing resolutions, showing K (blue), Zn (red), Co (green), and P (green in last image) inclusions.

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