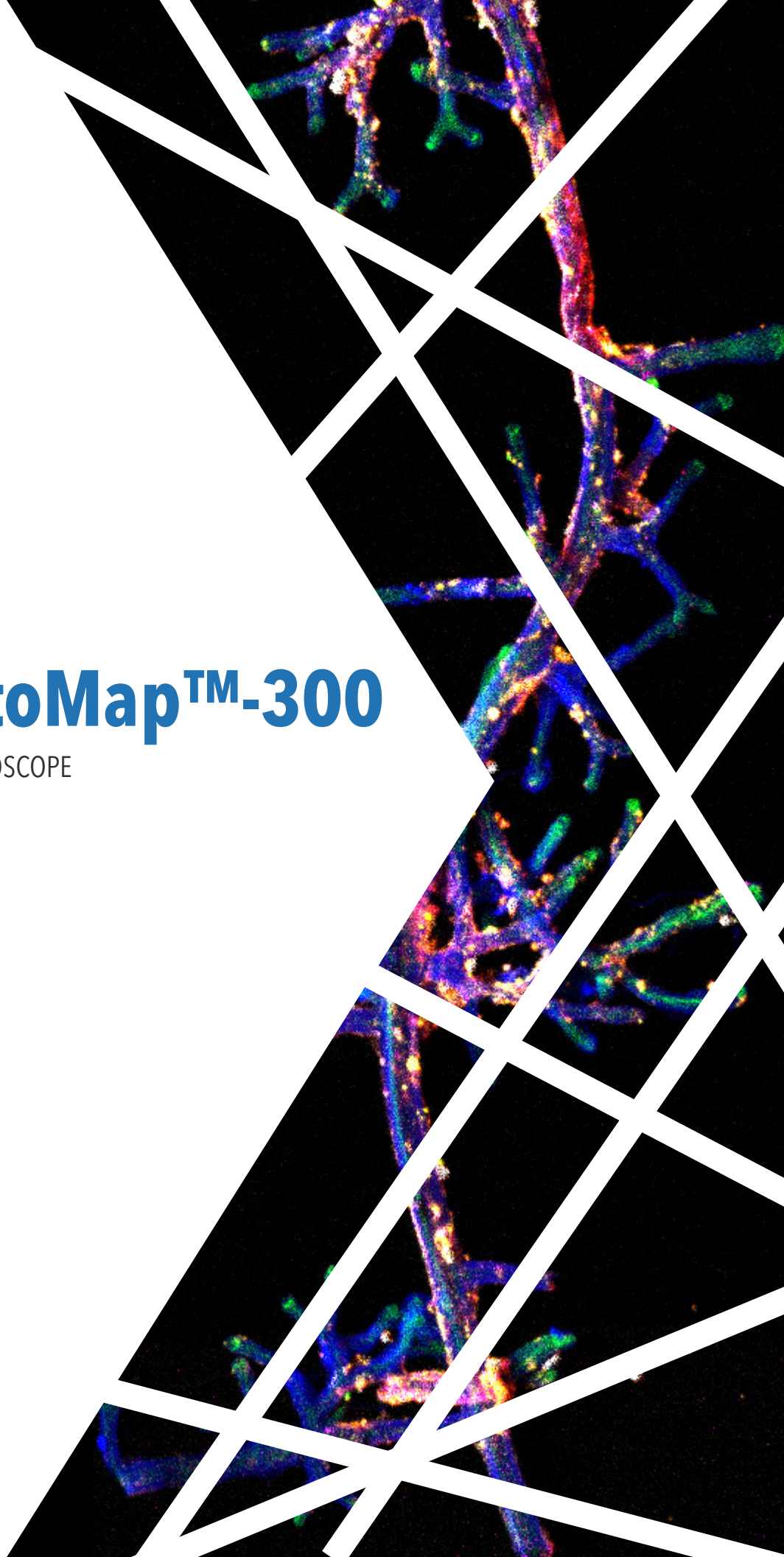

SIGRAY

Sigray AttoMap™-300

X-RAY FLUORESCENCE MICROSCOPE

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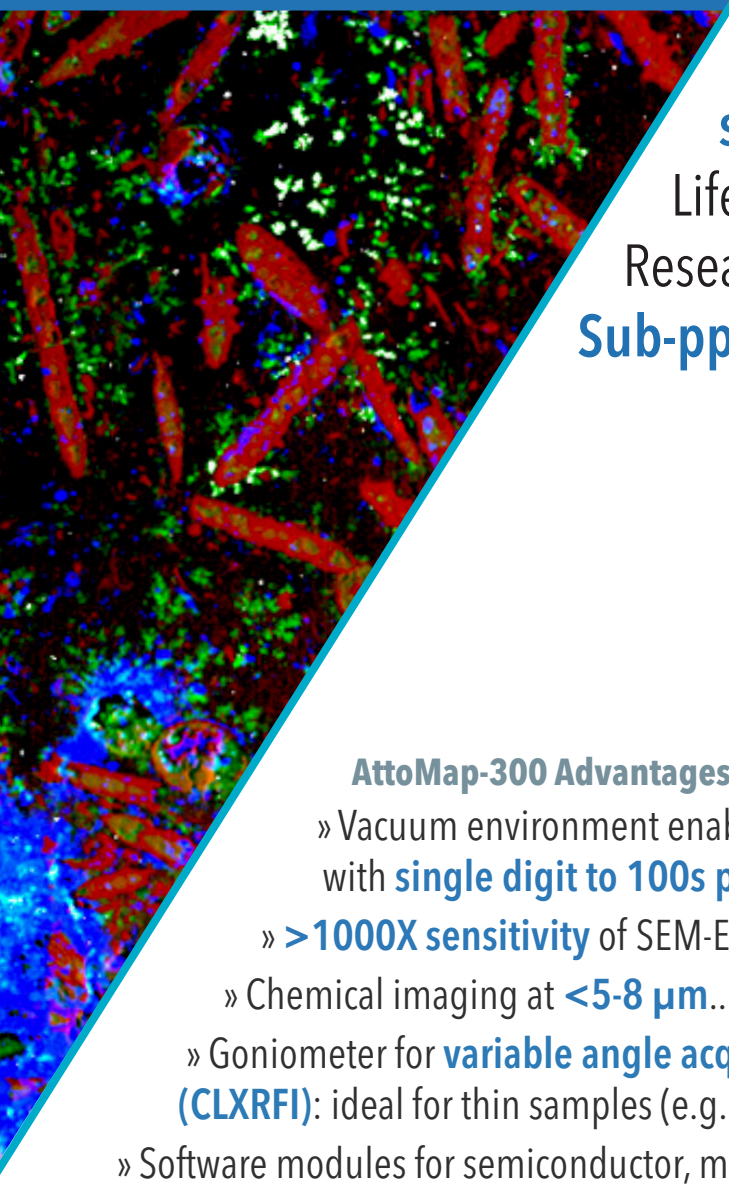
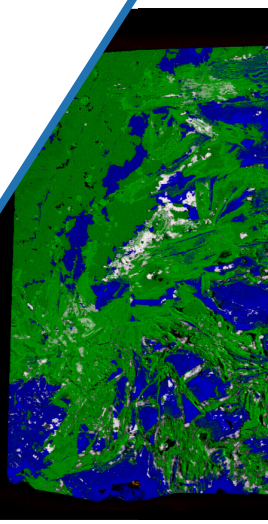


Core rock with dendritic grains. A full spectrum (including elements of interest S, Ba, Si, K, Ca, Fe, Mn, and Ti) was mapped. Shown in composite image are Ca (red), Mn (green), Fe (blue), and Ba (gray).
Sample provided by Dr. Sudipta Dasgupta, IIT Bombay



Quantitative Elemental Imaging at Microns-scale for Semiconductor, Life Sciences, & Geology Research **at the Highest Sub-ppm Sensitivities**

AttoMap-300 Advantages at a Glance

» Vacuum environment enables simultaneous acquisition of elements down to B, with **single digit to 100s ppm sensitivities for organics** (e.g. C, O, N)

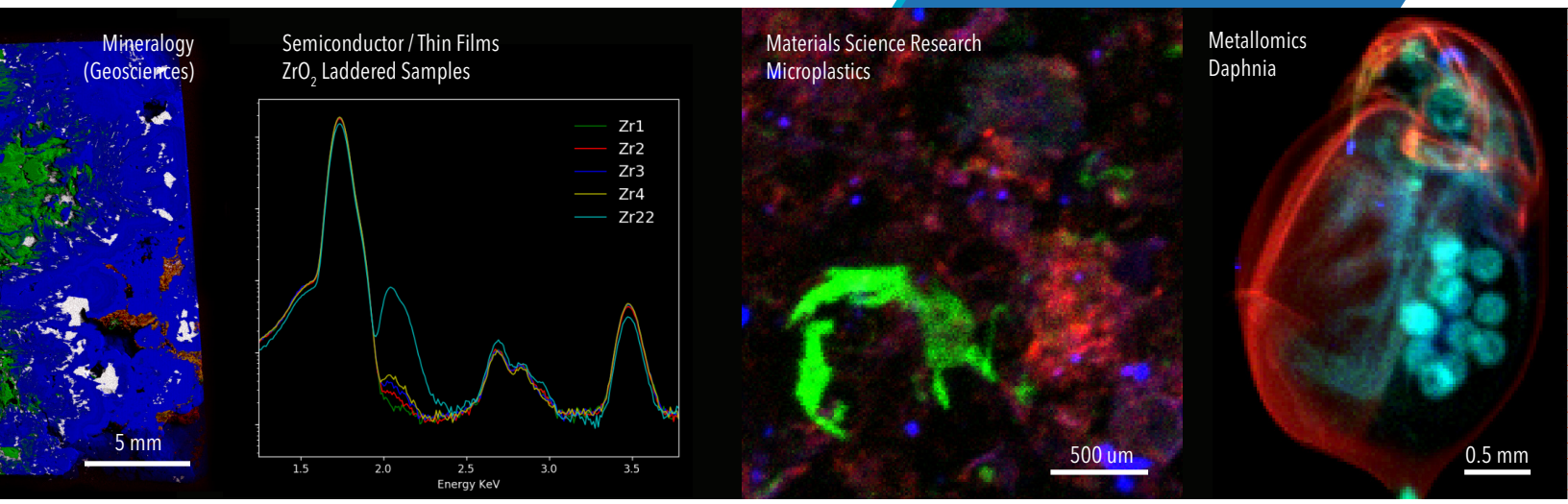
» **>1000X sensitivity** of SEM-EDS, reaching **sub-angstrom** LLDs for thin films

» Chemical imaging at **<5-8 µm**... and down to **5 ms/point**

» Goniometer for **variable angle acquisition** and new Computed Laminography XRF Imaging **(CLXRFI)**: ideal for thin samples (e.g. tissue and rock sections) and removing diffraction peaks

» Software modules for semiconductor, mineralogy, and quantitative weight percent analyses

Applications include trace elements in life sciences (metallomics), mineralogy (organics & rare earths), and semiconductor high-k dopants & film thicknesses



Bring Synchrotron XRF Capabilities to Your Lab

Conduct Ground-breaking Research without Needing to Apply for Beamtime

Sigray's AttoMap™ x-ray fluorescence microscopes are breakthroughs 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 patented x-ray source and 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.

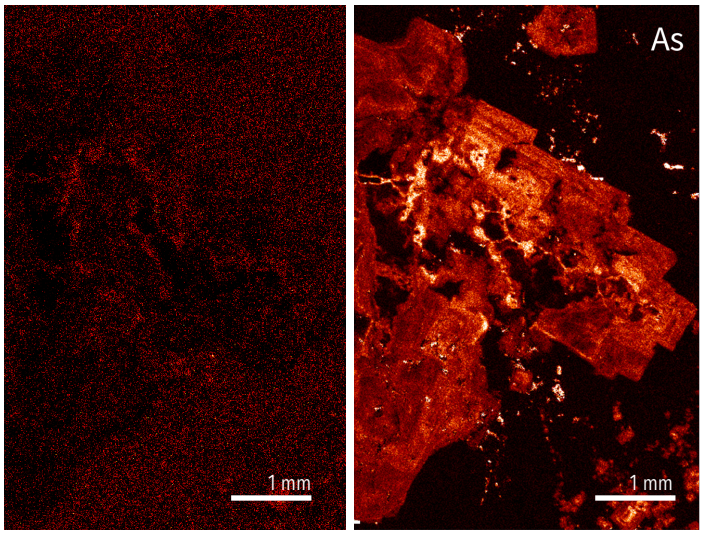


Figure 1: Sigray's patented x-ray source in combination with its multi-optics system enables **energy tunability**, a capability not possible outside of the synchrotron. By switching to different x-ray source targets (which changes incident x-ray energy), sensitivity for an element can be increased up to 1000X. Above is the Arsenic channel of the same geological sample at different incident energies (W source/optic, left, vs. Mo source/optic, right).

AttoMap-300 Specifications

Parameter	Specification
Spatial Resolution	Resolution <8 µm
Sensitivity	Sub-ppm relative detection sensitivity and capable of mapping trace elements. Picogram to femtogram absolute sensitivity (element & acquisition time dependent)
Additional Capabilities	Optical microscopy and x-ray transmission microscopy included
Footprint	54" W x 65.5" H x 38.5" D
Stage Travel	100 x 100 mm (upgrades available upon request)
Variable Angle Acquisition	0 to 70 degrees, in 0.01 degree increments
Maximum Sample Size	100 x 100 mm standard operation, ~30 x 30 mm at grazing angles | 20 mm thickness
Source	Sigray Patented High Brightness Microfocus Source
Target Material	Multiple x-ray targets (up to 4) includes selection from: SiC, Cr, Cu, Rh, W, Mo, Au, 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%
Magnification	1:1 Magnification Default; Demagnifying optics for higher resolution available upon request
Interior Coating	Platinum (increases collection efficiency of optic significantly)
X-ray Detectors	SDD Detector, 30 mm^2
Energy Resolution	<129 eV at Mn-Ka | <=136 eV at 5.9 keV

Comparison: AttoMap-200 and AttoMap-300

Parameter	AttoMap-200	AttoMap-300
Element Range	Na to U	B to U
Variable Angle Acquisition	Normal Incidence (0 degree) and flip-up stage (70 degree)	Enables full range of acquisition angles from 0 to 70 degrees
Diffraction Peak Removal	Can identify (using dual detector option)	Can fully remove (by optimizing angle)
X-ray Source Targets	Cr, Cu, Au, Mo, Rh, W	SiC, Rh, Cr, Cu, Au, Mo, Rh, W
Silicon Background	Present	Use of SiC x-ray target removes Si background (impt for semi & geo)
Stage Travel	200 x 200 mm standard Upgradeable to 300 x 300 mm	100 x 100 mm Upgrades available upon request
Detector	Large format, high performance SDD	High grade SDD optimized for low energy
Vacuum Capabilities	He-flush	Vacuum chamber

REV20201001

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