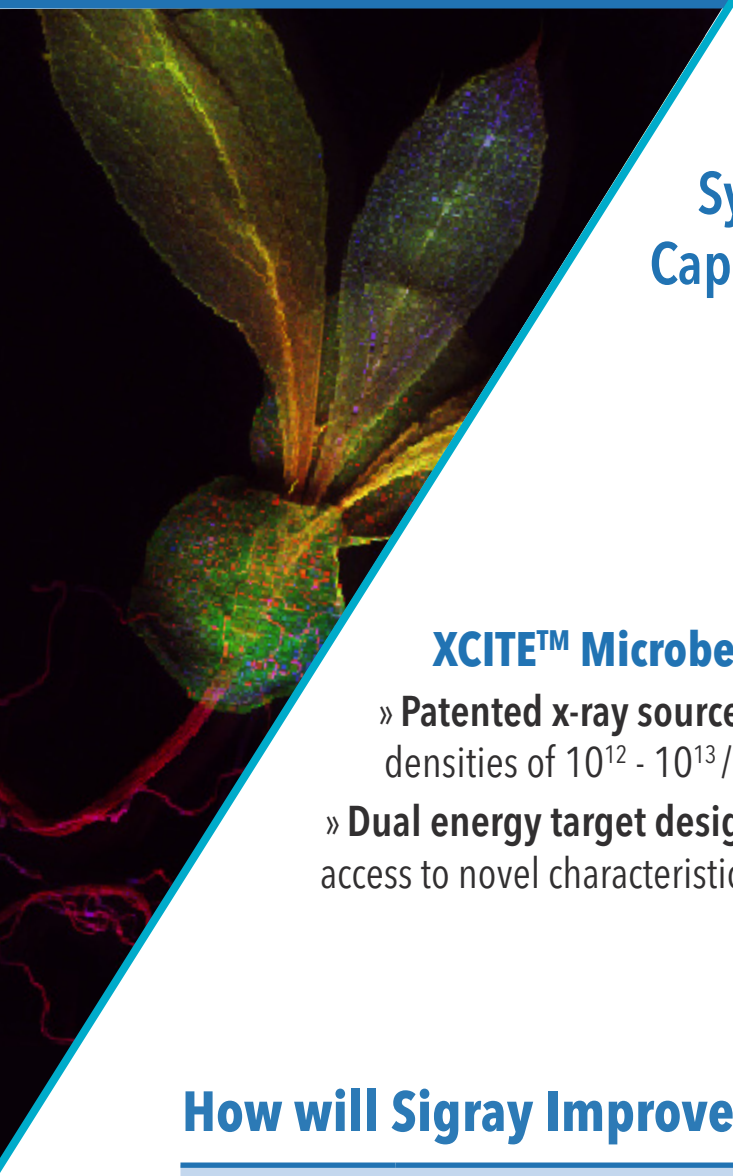
SIGRAY

Sigray XCITE™

HIGH BRILIANCE X-RAY MICROBEAM SYSTEM

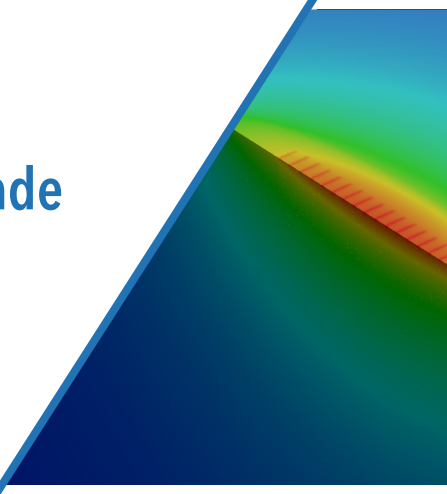
Sigray is proudly represented in
Australia and New Zealand by
AXT Pty. Ltd.
1/3 Vuko Pl., Warriewood
NSW 2102 Australia
T. +61 (0)2 9450 1359 F. +61 (0)2 9450 1365
W. www.axt.com.au E. info@axt.com.au

Sigray, Inc.
5750 Imhoff Drive, Suite I,
Concord, CA 94520 USA
P: +1-925-232-1991
F: +1-925-293-0733
sigray.com
info@sigray.com



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

Develop & Upgrade Laboratory X-ray Instruments with Synchrotron-like Capabilities



XCITE™ Microbeam System at a Glance

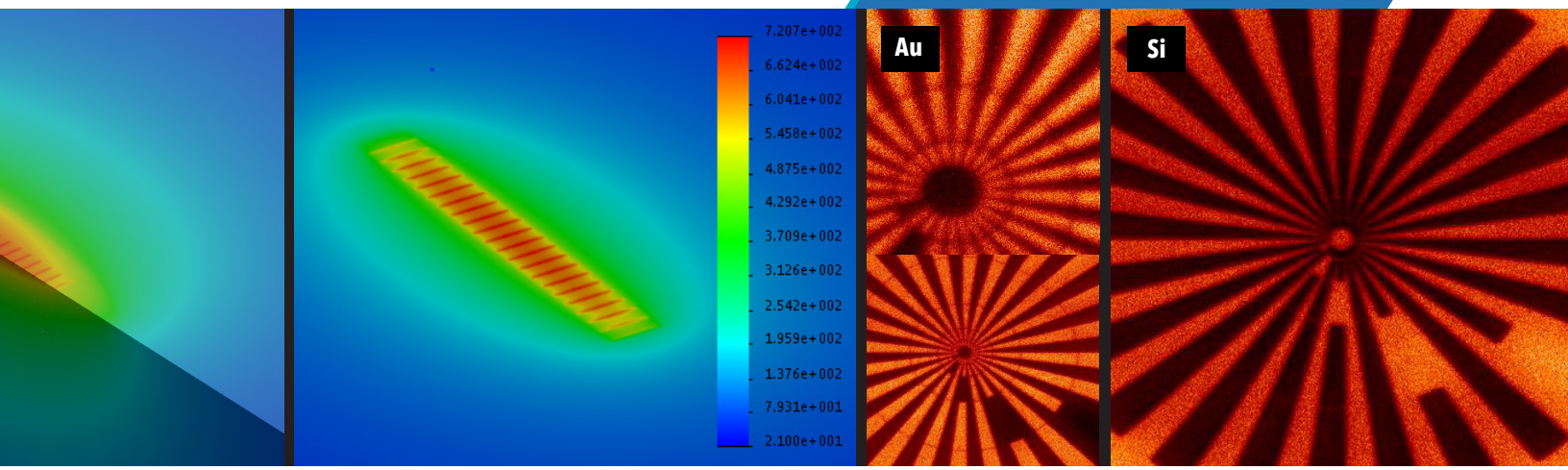
» **Patented x-ray source and optic technology** with outstanding x-ray flux densities of 10^{12} - 10^{13}/mm^2 at the sample

» **Dual energy target design** for user-selectable choice of x-ray spectra, including access to novel characteristic energies and spectra using unorthodox target materials

How will Sigray Improve Your System Performance?

Microbeam Type	Applications	Sigray Advantage
Focusing	MicroXRF, X-ray Microscopy, MicroXRD, protein crystallography	Ultrafine spot size of <10 µm achieved at large working distances Achromatic single focal point for accurate quantification
Collimating	SAXS, XRR, HRXRD	Highly collimated microbeam with <0.3 mrad divergence

Left (2): Finite Elemental Analysis demonstrating thermal advantages of microstructured target
Right (3): Resolution measurements (<10 µm) from microXRF elemental maps using XCITE as the illumination beam system



Bring Synchrotron Beamline Capabilities to Your Lab

Conduct Ground-breaking Research without Needing to Apply for Beamtime

The XCITE™ is a patented source and optic combination designed to enable synchrotron performance to laboratory x-ray microanalytical techniques.

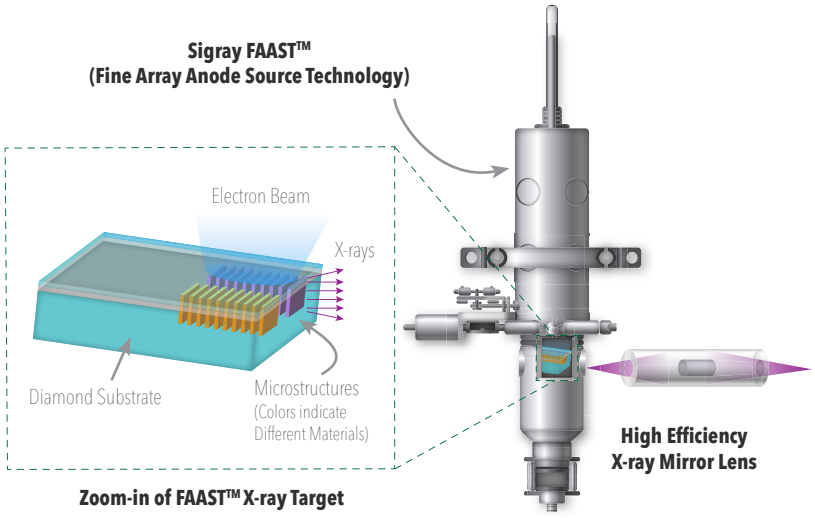
High Brightness X-ray Source with >50X Brightness

The Sigray FAAST™ x-ray source features an x-ray target comprised of fine metal microstructures encapsulated in a diamond substrate. Diamond provides unique thermal advantages, that, due to the high degree of contact between the microstructures and the substrate, allows substantially higher power loading for powerful flux (up to 10^{12} - 10^{13} x-rays/mm^2) and access to new x-ray target materials.

High Efficiency X-ray Mirror Lens

Sigray has developed a high precision and advanced manufacturing process capable of producing lenses with minimal slope errors and a reflecting surface smoothness on the order of single digit angstroms. These high performance lenses are achromatic and come in two configurations for the XCITE™: a minimal-divergence collimating lens and a high resolution focusing optic. The performance of the lens is far superior in performance than conventional polycapillary and monocapillary (tapered, elliptical, etc) optics.

Schematic of the XCITE™ X-ray Microbeam Delivery System



* Patent: US 9/449,781B2

XCITE™: Specifications

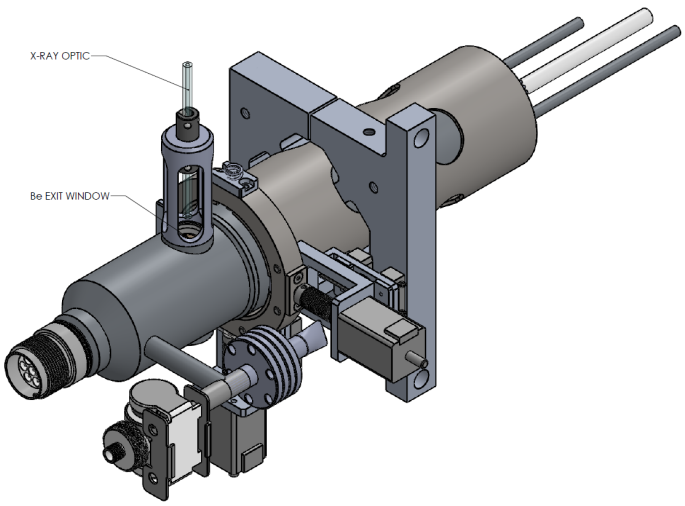
Parameter	Specification
Spot Size (Focused Beam Option)	<10 µm achromatic focal spot at 10-50 mm WD
Divergence (Collimated Beam Option)	<300 µrad (beam stop used)
Flux Density	10^{12} - 10^{13} / mm^2
Source	Sigray FAAST™ Microstructured Source
Target Material	Dual Energy Option. Includes selection from: Ti, Cu, Pt, Mo, W, and more. See table below to understand advantages of Dual Energy
Target Substrate Material	Diamond
Power | Voltage | Current	50 W | 20 - 50 kV | 4 mA
X-ray Optic	Sigray Twin Paraboloidal X-ray Mirror Lens
Transmission Efficiency	~80%
Interior Coating	Platinum (increases NA of optic significantly)

What is the Advantage of Dual Energy?

Example: Optimization of X-ray Fluorescence Signal

	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

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



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