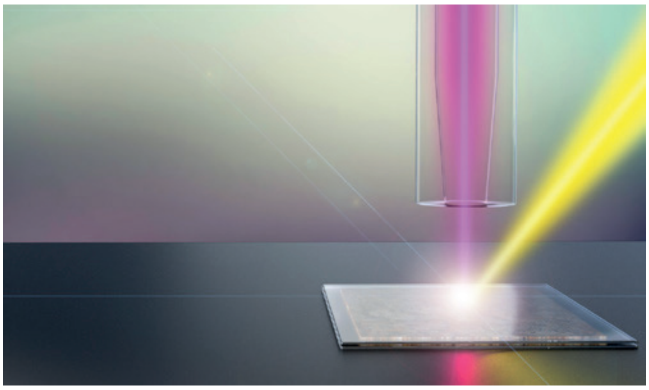
Twin paraboloidal x-ray mirror lens
Highest resolution for laboratory instrument development



Designed for ultrabright micro/nanofocus sources

X-ray source technology has advanced considerably, with the introduction of smaller spot sizes, such as new nanofocus transmission types, and alternative anode designs, such as liquid metal anodes and the microstructured target design employed by Sigray's FAAST™ (Fine Array Anode Source Technology) ultra high brightness source. However, x-ray optics capable of taking advantage of the brightness offered by these small spot x-ray sources have not been commercially available until now.

Sigray's twin paraboloidal mirror lens achieves point spread functions of <3-20 µm to fully preserve brightness for a wide range of sources, including modern ultrabright small spot source designs:

Optics PSF	X-ray source size			
(Point spread Fn)	1 µm	5 µm	10 µm	20 µm
1 µm	5%	100%	100%	100%
5 µm	4%	50%	80%	94%
10 µm	1%	20%	50%	80%
20 µm	0.25%	6%	20%	50%

Table: Preservation of x-ray brightness as a function of the optics point spread function (PSF) in microns and x-ray spot size. Shown is how a small psf is critical for small spot sources (e.g. 5 um), for which a polycapillary optic (>20 µm psf) would only preserve <20% of brightness.

Sigray's twin paraboloidal mirror lenses provide:

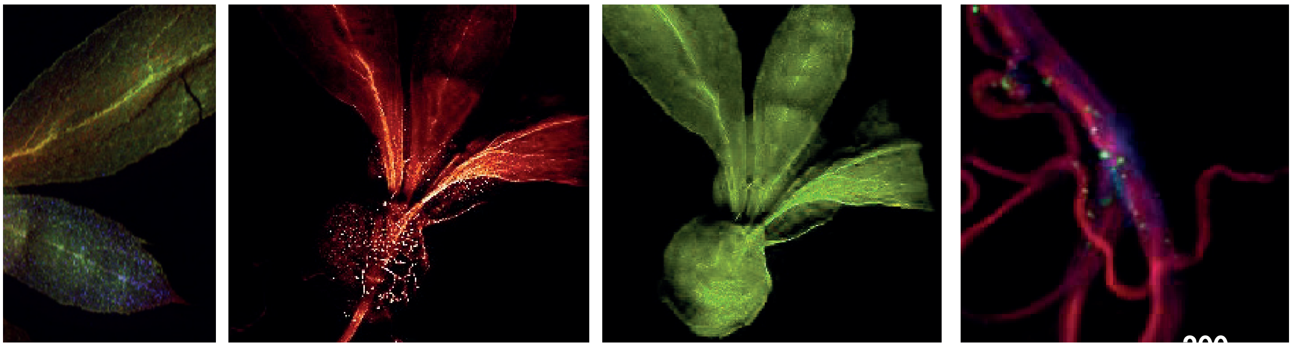
- High resolution (<8-20 µm)
- Large working distances
- Achromatic, symmetric spot with minimal tailing
- Intense flux delivery to focus

Unsurpassed performance from advanced manufacturing techniques

Due to the extremely small critical angle of reflection for x-rays, the fabrication of high resolution and high efficiency x-ray optics is an extremely challenging process that demands sophisticated, high precision techniques. Through substantial government funding, Sigray's team of the leading x-ray optics experts in the world has developed proprietary, state-of-the-art optics shaping systems for near-zero (angstrom-scale) surface roughness and minimal slope errors for the highest quality optics available.

Twin paraboloidal X-ray mirror lens: Illustration of the point-to-point focusing of a Sigray optic with two opposing paraboloids. The first paraboloid collimates a diverging beam, and the second paraboloid focuses the collimated beam onto a tight, achromatic focal spot.

Parameter	Specification
Spot size	<8 to 20 µm (customizable)
Reflecting surface	Coated with Platinum for high numerical aperture; other materials available by request
Working distance	10 – 100 mm (customizable)
Transmission efficiency	~ 80% compare to 5-15% of polycapillary optics
Focus chromaticity	Achromatic
Spectral bandpass	Wide with a high energy cut-off
Normalized phase acceptance	3 compare to 1 for polycapillary



MicroXRF mapping of a hyper accumulating seedling using common laboratory source with double paraboloidal optic. Elemental overlay map relating the distribution of three selected elements of interest (K, Cl, S) and roI scan of trace elemental (Mn, ni) accumulation in the seedling roots.

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

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SIGRAY

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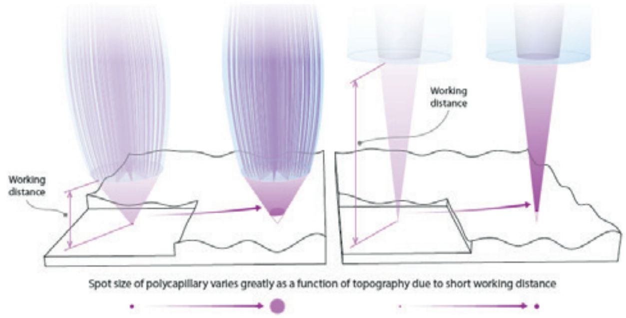
Breakthrough X-ray optic advantages

The choice of X-ray optics for laboratory x-ray micro-analytical techniques has traditionally been limited to polycapillaries. Sigray's twin paraboloidal x-ray mirror lens provide a number of critical advantages over the known shortcomings of polycapillaries.

Advantage 1
Highest resolution laboratory x-ray optic

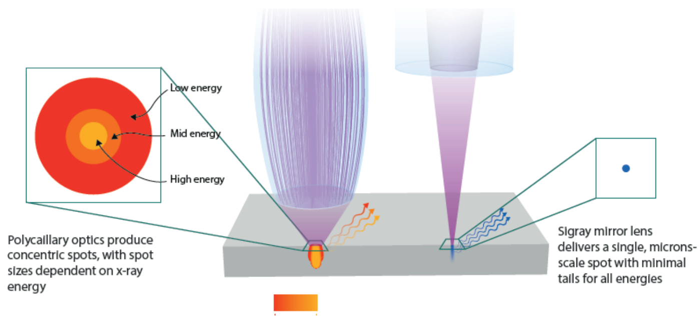
Advantage 2
Substantially larger working distances

Polycapillaries require short working (optic-sample) distances for optimal performance, resulting in widely varying resolution if sample surfaces have even minimal topography and is problematic for accurate analysis.



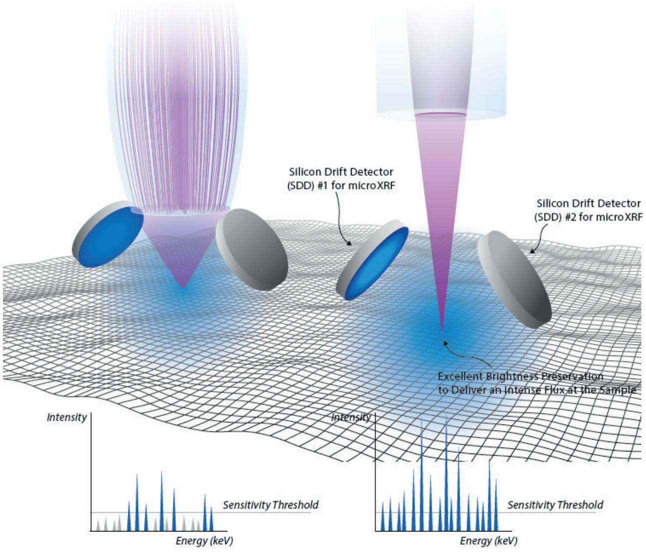
Advantage 3
Achromatic, energy-independent focal spot

The focal spot of Sigray's mirror lens is a single, sharp focal spot with minimal tailings for all energies. In comparison, polycapillaries generate substantially larger spot sizes that are dependent on energy (chromatic), with lower energy x-rays producing larger spots.



Advantage 4
Excellent brightness preservation for high flux

The excellent point spread function (psf) of the Sigray optics imparts unequaled preservation for ultrabright x-ray sources, enabling faster (minutes vs days) and higher sensitivity microanalysis for challenging applications such as mapping trace elements with microXRF.



Additional advantages & comparisons vs. monocapillaries

Sigray's x-ray mirror lens additionally offer: customization to your specific application, superior focusing of low energy x-rays and alternative, non-focusing configurations for collimating with minimal divergence.

When compared to monocapillaries (e.g. elliptical, tapered, straight), the mirror lens provide tremendous benefits, including: smaller focal spot, minimal aberrations, and orders of magnitude greater flux.

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