Polycapillary X-ray Optics for Micro XRF and XRD

XOS is the leading global manufacturer of polycapillary X-ray optics. These state-of-the-art optics capture a large solid angle of X-rays from a source and redirect them to a micron-sized focal spot or highly collimated beam. The use of polycapillary optics can significantly enhance the performance of X-ray analysis in many applications, including X-ray fluorescence (XRF) and X-ray diffraction (XRD).

Features and Benefits

• X-ray flux density gain up to 10,000 times greater than conventional pinhole collimator
• Focal spot as small as 5µm
• Broad spectral bandwidth: 10eV-50keV
• Customizable optic design for optimal performance
• Halo reduction optics optimized for high-energy applications
• Increased analytical speed in micro XRF for fine-feature analysis and high-resolution mapping
• Large, quasi-parallel X-ray beam for XRD and XRF
Custom Optic Solutions

XOS offers custom polycapillary X-ray optic solutions based on customer application requirements. Below are typical X-ray optic geometries, performance specifications and applications.

### Focusing Optics

<table>
<thead>
<tr>
<th>Working distance (mm)</th>
<th>2</th>
<th>4</th>
<th>9</th>
<th>20</th>
<th>50</th>
<th>100</th>
<th>200</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Focal spot size</strong> (µm, FWHM, 17.4keV)</td>
<td>7</td>
<td>15</td>
<td>25</td>
<td>45</td>
<td>100</td>
<td>180</td>
<td>300</td>
</tr>
<tr>
<td><strong>Intensity gain</strong> (vs a pinhole collimator of same size, 100mm from the source)</td>
<td>6000</td>
<td>4500</td>
<td>3500</td>
<td>2000</td>
<td>800</td>
<td>300</td>
<td>120</td>
</tr>
</tbody>
</table>

Applications include micro-XRF for elemental mapping, plating thickness and fine feature analysis.

Note: *With a 100µm X-ray source.

### Half-focusing Optics (XRF/XAS)

<table>
<thead>
<tr>
<th>Working distance (mm)</th>
<th>2</th>
<th>4</th>
<th>9</th>
<th>20</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Focal spot size</strong> (µm, FWHM, 17.4keV)</td>
<td>7</td>
<td>15</td>
<td>25</td>
<td>45</td>
<td>100</td>
</tr>
<tr>
<td><strong>Intensity gain</strong> (vs a pinhole collimator of same size)</td>
<td>850</td>
<td>550</td>
<td>400</td>
<td>200</td>
<td>80</td>
</tr>
</tbody>
</table>

Applications include micro XRF, micro XAS, and confocal XRF.

Note: *With an incident beam of 2mm in diameter and a divergent angle of <0.5mrad

### Collimating/Parallel Beam Optics (XRD/WDS/XRF)

<table>
<thead>
<tr>
<th>Output beam diameter (mm)</th>
<th>0.5</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>6</th>
<th>10</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intensity gain</strong> (vs a pinhole collimator of same size)</td>
<td>12</td>
<td>45</td>
<td>130</td>
<td>250</td>
<td>370</td>
<td>470</td>
<td>680</td>
<td>850</td>
</tr>
</tbody>
</table>

Applications include powder XRD, texture and stress analysis, WDS and confocal XRF.

Note: *With a 50µm X-ray source at 8keV, The IFD of the optics is 18mm and the output divergent angle is 0.2 degree.

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**Figure 1: Spectra of X-rays Scattered from Plexiglas**

Comparison of MXRF spectra generated using a focusing polycapillary optic and a pinhole aperture. The spectra was collected by scattering a Mo beam off Plexiglas.

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**Figure 2: High-resolution XRF Mapping Using a Halo Reduction Polycapillary Optic**

1D XRF scan (bottom), of a copper PCB sample (top), using both a regular and a halo reduction polycapillary optic, each with a 15µm focal spot. The high-energy halo effect is clearly visible with regular optic while it is eliminated with the halo reduction optic.