# Silicon Pore Optics Technology

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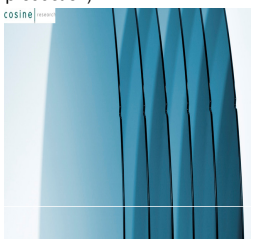
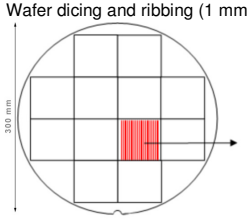
Commercial high-quality 12” wafers (DRAM production)



Wafer dicing and ribbing (1 mm pitch, 0.2 mm width)



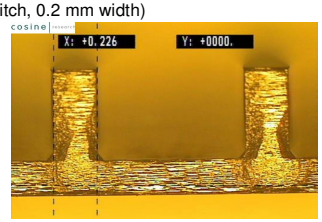
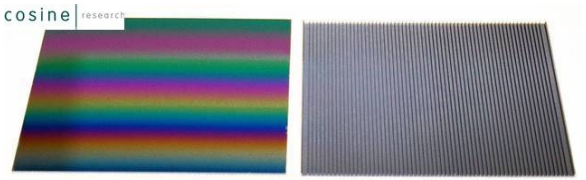
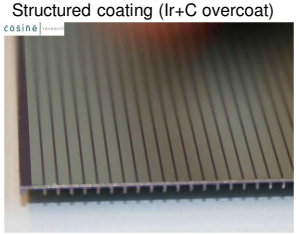
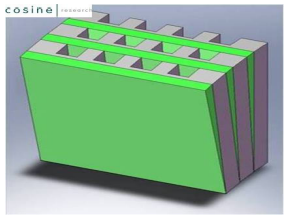




Plate wedging (0.02” accurate wedge angle)

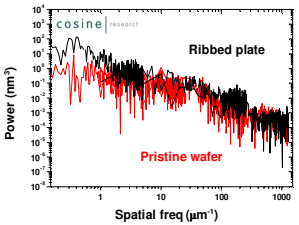


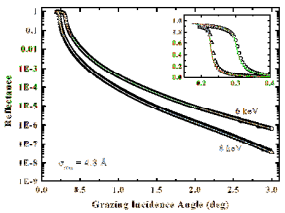
Structured coating (Ir+C overcoat)

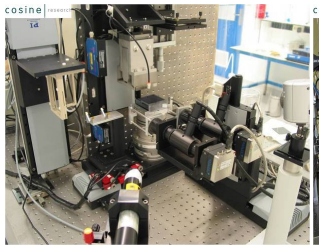




Surface roughness 0.15 nm (AFM), 0.48 nm (X-ray, 8 keV)

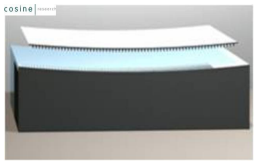


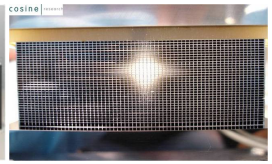



Silicon pore optics have been developed over the last years to enable future astrophysical X-ray telescopes and have now become a candidate mirror technology for the IXO mission.

Scientific requirements demand an angular resolution better than 5” and a large effective area of several square meters at photon energies of 1 keV.



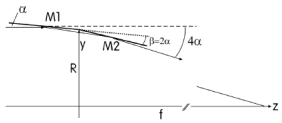


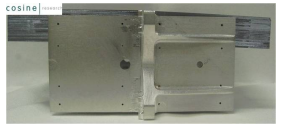
These novel light, stiff and modular X-ray optics, are based on ribbed plates made from commercial high grade 12” silicon wafers. Stacks with several tens of silicon plates have been assembled in the course of an ESA technology development program, by bending the plates into an accurate shape and directly bonding them on top of each other.

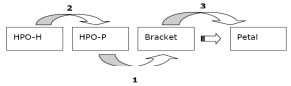
Several mirror modules, using two stacks each, have been aligned and integrated to form the conical approximation of a Wolter-I design.

[1] Beijersbergen, M. et al., "Development of x-ray pore optics: novel high-resolution silicon millipore optics for XEUS and ultralow mass glass micropore optics for imaging and timing", Proc. SPIE 5539, 104-115 (2004).
[2] Bavdaz, M. et al., "Progress at ESA on high-energy optics technologies", Proc. SPIE 5168, 136-147 (2004).
[3] Mieremet, A. L. & Beijersbergen, M. W., 'Fundamental spatial resolution of an x-ray pore optic', Applied Optics 44 (2005), 7098—7105.
[4] Collon, M. J. et al., "Silicon pore optics for astrophysical x-ray missions", Proc. SPIE 6688, 668813 (2007).

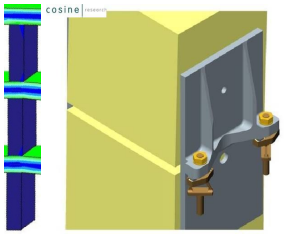
Mirror module: 2 silicon stacks and 2 brackets



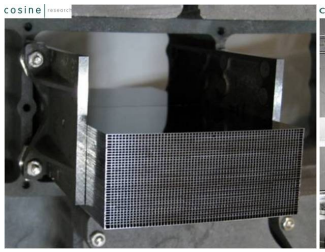





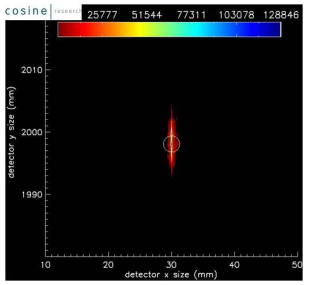

Three point mounting, isostatic, stress free



Mounted optics X-ray tested at BESSY and PANTER

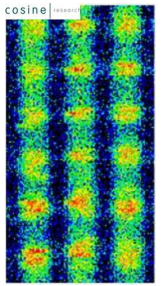


Predicted focal image 17”x2” HEW




BESSY synchrotron
3 keV

Intrafocal image



PANTER long-beam facility
3 keV