Hard X-Ray Nanoprobe with Refractive X-Ray Lenses

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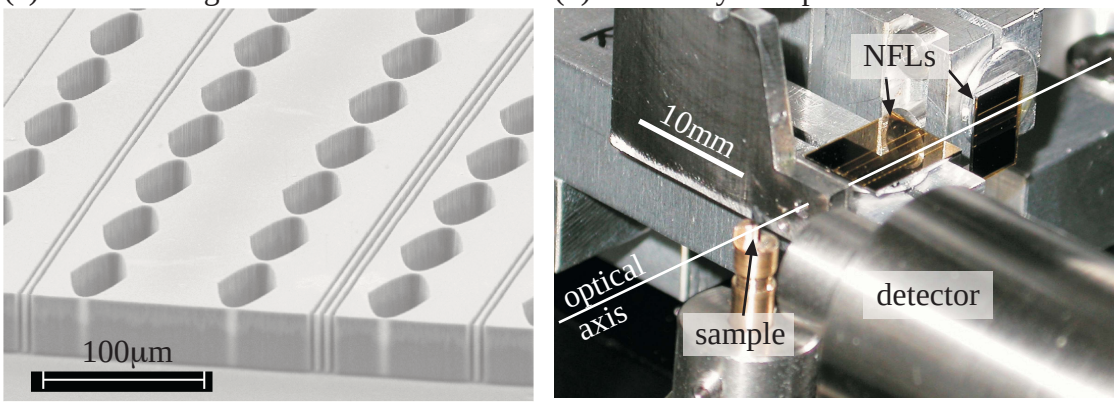
At synchrotron radiation sources, parabolic refractive x-ray lenses allow one to built both full field and scanning microscopes in the hard x-ray range. For the latter microscope, a small and intensive microbeam is required. Parabolic refractive x-ray lenses with a focal distance in the centimeter range, so-called nanofocusing lenses (NFLs), can generate hard x-ray nanobeams in the range of 100nm and below, even at short distances, i. e., 40 to 70m from the source [1]. Recently, a $50 \times 50\mathrm{nm}^2$ beam with $1.6 \cdot 10^8 \mathrm{ph/s}$ at $21\mathrm{keV}$ (monochromatic, Si 111) was generated using silicon NFLs in crossed geometry (cf. Figure) at a distance of 47m from an undulator source (ID13) at the European Synchrotron Radiation Facility. This beam is not diffraction limited, and smaller beams may become available in the future. Lenses made of more transparent materials, such as boron or diamond, could yield an increase in flux of one order of magnitude and have a larger numerical aperture. The fundamental limit for focusing with refractive lenses lies below 5nm [2].

(a) nanofocusing refractive lenses (b) hard x-ray nanoprobe



References:

[1] C. G. Schroer *et al.*, Appl. Phys. Lett. **82**, 1485 (2003).
[2] C. G. Schroer and B. Lengeler, Phys. Rev. Lett. **94**, 054802 (2005).