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An efficient polycapillary beam collimator for soft X-rays

A halved polycapillary lens (PCL) may be used as an efficient collimator in the soft X-ray domain. We present recent results of laboratory-based experiments with a micron-sized fluorescence source (Carbon K_α line, 277 eV). Its emission is collected by the PCL and converted into an almost parallel beam, with a residual angular divergence less than 7 mrad. As evaluated by a CCD camera at six positions along the maximal propagation distance of 0.9 m, the beam diameter spreads to no more than (5.6 ± 0.2) mm (FWHM). The measured 3-D beam profile is reproduced by simulations approximately, applying a newly developed ray tracing code witten in the Mathematica^{TM} / Optica^{TM} language. It turns out that both the experimental and the theoretical intensity distribution can be well described by the same, universal fit model. We guess that our findings may open the door to compact and versatile, table-top metrology of optical components in the soft X-ray range – with high efficiency: to verify the gain provided by the PCL, the photon flux through a narrow slit ($\sim$ 1 mm) is recorded in a variable distance of several 10^{-1} m from the collimator's exit aperture. In comparison to unconfined radiation, the PCL yields an up to 90 $\times$ enhanced count rate on the detector. In this way, relatively weak laboratory X-ray sources, equipped with customized polycapillary lenses, might enable quick and flexible in-house testing of the reflectivity of mirrors, or the diffraction efficieny of transmission and reflection zone plates in the future, for instance.

Journal of Synchrotron Radiation Special Issue: will you submit your contribution?

yes

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