MS39-P03 | Development of Channel-cut X-ray optics for laboratory small-angle X-ray scattering setups

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A modern small-angle X-ray scattering (SAXS) laboratory setup equipped with a micro-focus X-ray source coupled to 2D collimating Montel optics provides a beam with relatively low divergence of hundreds of µrad. Nevertheless, resolution of such a setup in small angle region is still limited by the divergence of X-ray beam. To increase resolution, it is often necessary to sacrifice big portion of beam intensity. Supposing 500 mrad divergence of the primary beam, comprehensive ray-tracing simulations of Ge(111) and Ge(220) channel-cut monochromators and their combinations were used to map the distribution of the output beam parameters over the entire space of the asymmetry angles of the respective diffractions. This allowed us to design a channel-cut based X-ray optics with theoretical loss in intensity of just one order of magnitude and the output divergence reduced by a factor of 5. The numerical simulations were validated by the experiments performed on a commercial SAXS setup (Bruker AXS, Nanostar) equipped with a liquid-metal jet anode X-ray source (Excillum, MetalJet D2+) and 2D collimating Montel optics, demonstrating thus potential of the combined reflective-diffractive X-ray optics for microfocus laboratory X-ray sources.