Effective Pinhole-Collimated USAXS at UNICAT* at the Advanced Photon Source

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Small-angle scattering is widely used for obtaining statistically significant information in the 1 nm to 100 nm size range. Ultra-small-angle x-ray scattering (USAXS), achieved through crystal collimation, extends this size range to include features over 1 \( \mu \)m in size.

USAXS [1] on UNICAT uses a six-reflection crystal pair as a collimator and another six-reflection crystal pair as an analyzer. Absolute calibration and slit-desmearing make this a very effective instrument, limited only by the fact that the measurement of anisotropic microstructures is excluded. This limitation is removed [2] by adding one horizontally reflecting crystal before and another after the sample. This creates an effective pinhole collimated USAXS. (Fig. 1) Now, anisotropic materials are probed in the same physically relevant, large (50 nm to 1 \( \mu \)m) size range as isotropic materials.

Samples are centered on the rotational axis of an azimuthal stage, which is centered on the x-ray beam. Two-dimensional scattering data are measured as the sample azimuth and the analyzer crystal pair are scanned. Fig. 2 shows the angular distribution of Porod constants derived from scattering by a thermally sprayed \( \text{Ca}_2\text{SiO}_4 \) deposit.

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References


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