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Characterization of a 20 nm hard X-ray focus by ptychographic coherent diffractive imaging

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Recent advances in the fabrication of diffractive X-ray optics have demonstrated hard X-rays focal spots below 30 nm. However, the characterization of these devices is not straightforward using conventional methods such as knife edge scans. Here, we have used ptychographic scanning coherent diffractive imaging to characterize a 20 nm-wide X-ray focus produced by Fresnel zone plate at a photon energy of 6.2 keV. A scanning transmission X-ray microscope was modified to perform the ptychographic scans on a test object. The ptychographic algorithms allowed the reconstruction of the image of the test object as well as the 3D reconstruction of a focused hard X-ray beam waist. The reconstructed wavefields confirm that the diffractive x-ray lenses were focusing the incoming radiation into spots as small as 20 nm. This method yields a full description of the focusing field at any propagation distance, including wavefront aberrations at the plane of the lens, and demonstrates its usefulness for metrology and alignment of nanofocusing X-ray optics. It is very robust against the longitudinal position of the sample, and requires no previous knowledge of the test object.

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Talk

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