PAUL SCHERRER INSTITUT

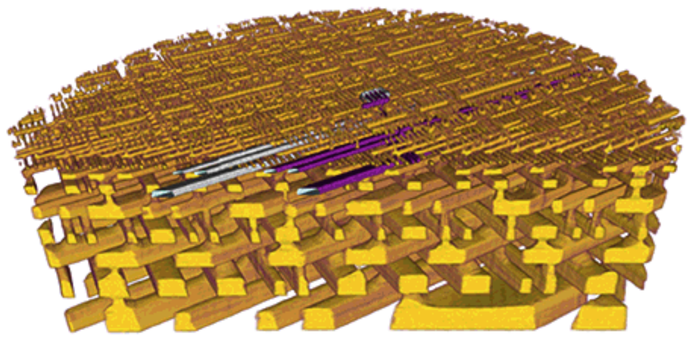
PSI facilities newsletter

https://www.psi.ch/science/facility-newsletter

Swiss Light Source Research Highlights

3-D X-ray imaging makes the finest details of a computer chip visible

High-resolution non-destructive three-dimensional imaging of integrated circuits
Mirko Holler, Manuel Guizar-Sicairos, Esther H. R. Tsai, Roberto Dinapoli, Elisabeth Müller, Oliver Bunk, Jörg Raabe, Gabriel Aeppli, Nature 16 March 2017, DOI: 10.1038/nature21698



3-D representation of the internal structure of a microchip (an Intel processor; Photo: Paul Scherrer Institute/Mirko Holler)

Researchers at the PSI have made detailed 3-D X-ray images of a commercially available computer chip. In their experiment, they examined a small piece that they had cut out of the chip beforehand. This sample remained undamaged throughout the measurement. It is a major challenge for manufacturers to determine if, in the end, the structure of their chips conforms to the specifications. Thus these results represent one important application of an X-ray tomography method that the PSI researchers have been developing for several years. Read more: https://www.psi.ch/sls/scientific-highlights-and-news

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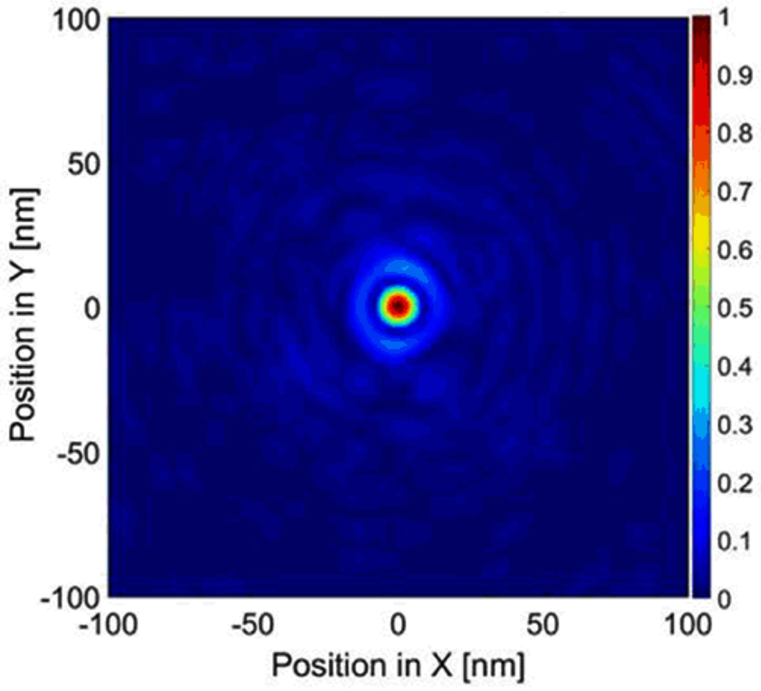
Interlaced zone plates push the resolution limit in x-ray microscopy

Istvan Mohacsi, Ismo Vartiainen, Benedikt Rösner, Manuel Guizar-Sicairos, Vitaliy A. Guzenko, Ian McNulty, Robert Winarski, Martin V. Holt & Christian David, Scientific Reports 7, Article number: 43624 (2017), doi:10.1038/srep43624



Focal spot of an interlaced diffractive x-ray lens showing a size of 7.8 nm (FWHM)

Multi-keV X-ray microscopy has been particularly successful in bridging the resolution gap between optical and electron microscopy. However, resolutions below 20 nm are still considered challenging, as high throughput direct imaging methods are limited by the availability of suitable optical elements. In order to bridge this gap, researchers of the Paul Scherrer Institute developed a new type of Fresnel zone plate lenses aimed at the sub-20 and the sub-10 nm resolution range. By extending the concept of double-sided zone plate stacking, we demonstrate the doubling of the effective line density and thus the resolution and provide large aperture, single chip optical devices with 15 and 7 nm smallest zone widths. The detailed characterization of these lenses shows excellent optical properties with focal spots down to 7.8 nm. Beyond wave front characterization, the zone plates also excel in typical imaging scenarios, verifying their resolution close to their diffraction limited optical performance.

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