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SUPPLEMENTARY INFORMATION

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Three-dimensional imaging of integrated circuits with macro- to nanoscale zoom

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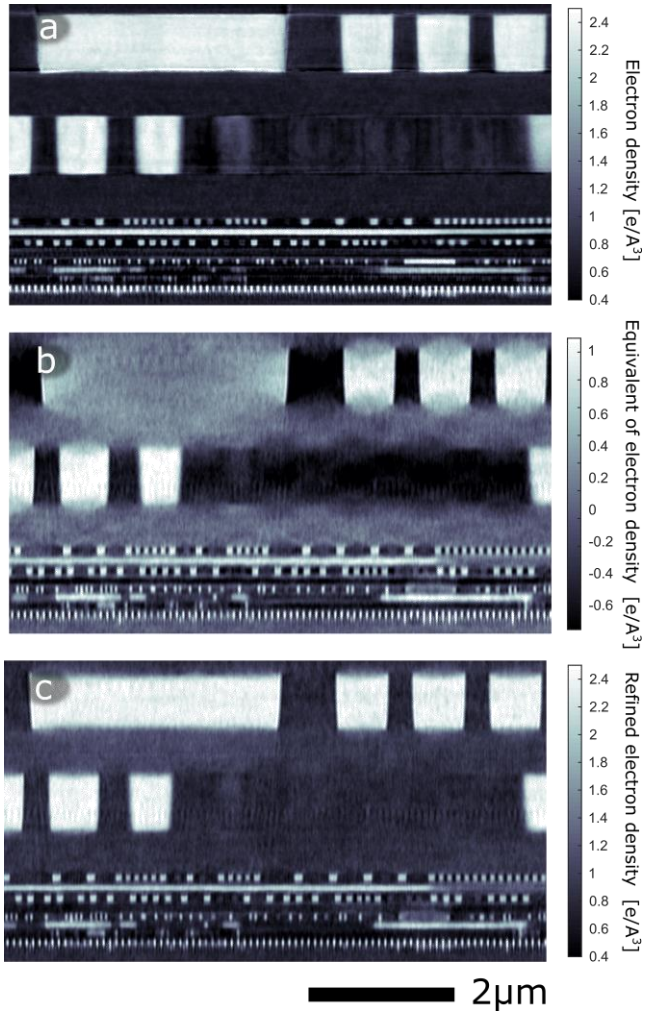
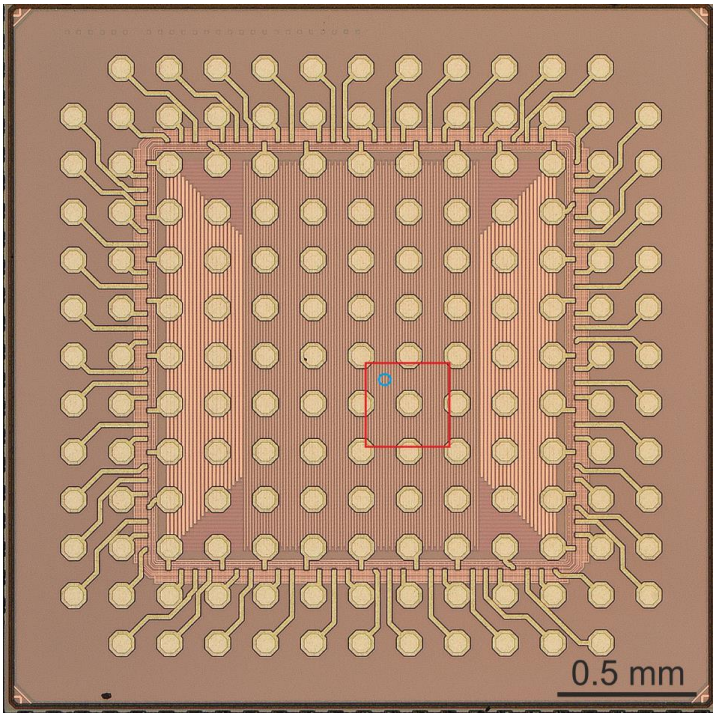
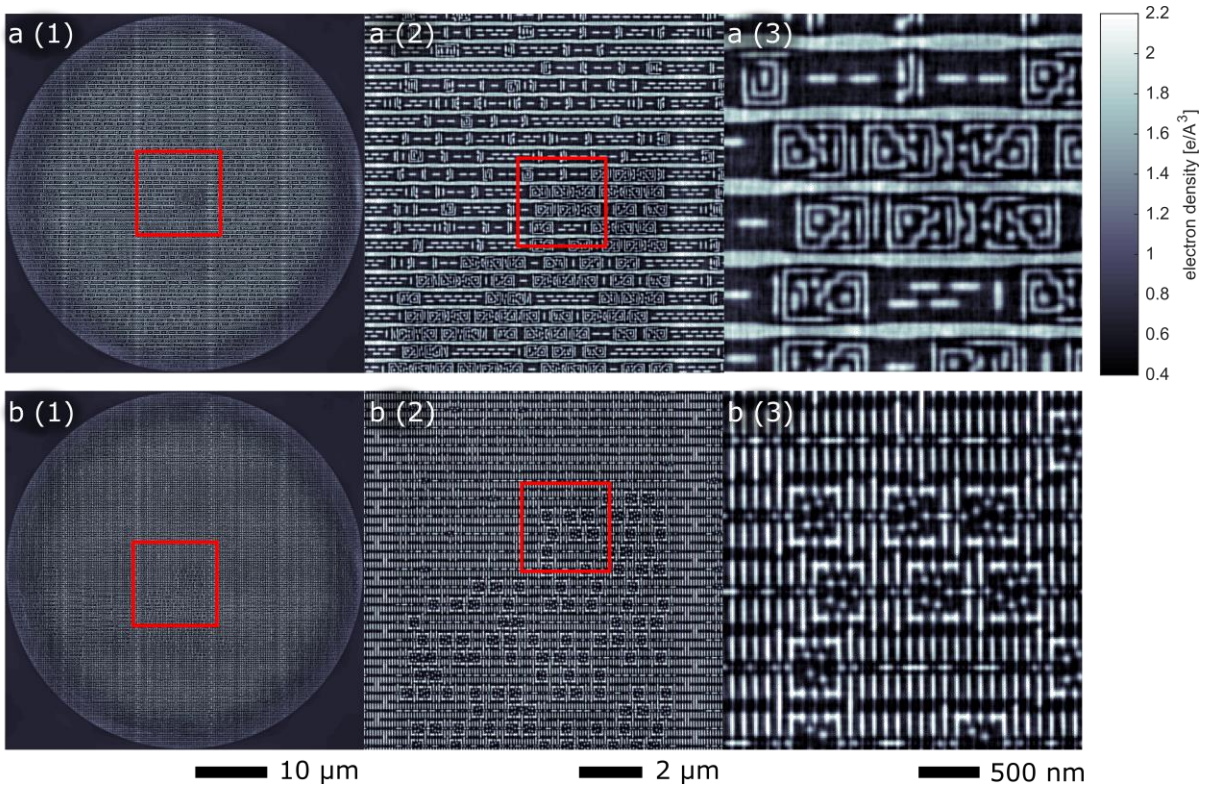


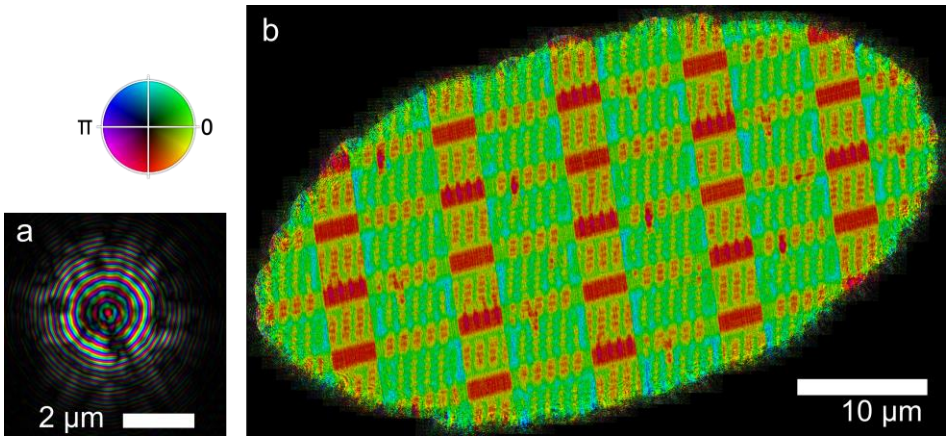
Supplementary Figure 1. Virtual coronal slices through the identical regions of the chip.
a measured by PXCT and **b** PyXL. In **c** the missing cone information was provided by a combination of material constraints and total variation minimization as described in the main text. Still it can be observed that the resolution in the vertical direction is worse compared to the horizontal direction as the missing information cannot be fully recovered in the case of PyXL.



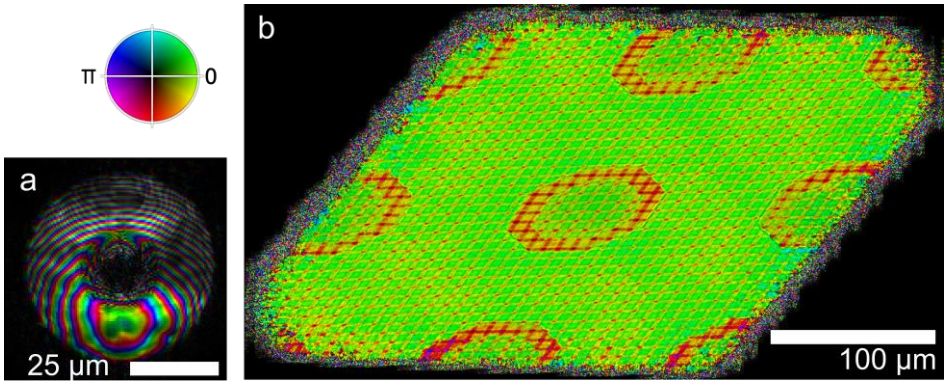
Supplementary Figure 2. Visible light microscopy image of the sample prepared for PyXL.
The chip is 2.5 x 2.5 mm^2 in area and the substrate was mechanically polished to a thickness of 20 µm. The red box indicates the area measured with PyXL at 500 nm resolution, and the blue circle indicates the area of the high-resolution scan.



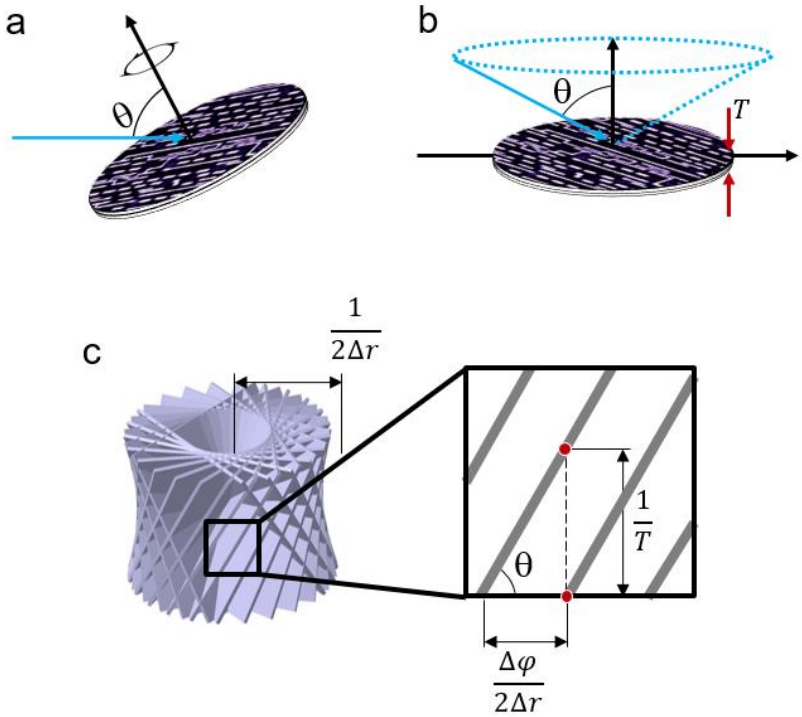
Supplementary Figure 3. Virtual slices through the two lowest metal layers. **a** shows layer M1 and **b** layer M0, of the dataset obtained by PyXL. The images on the right correspond to zoomed regions of the images to the left, where a (1), b (1) show the full reconstruction FOV of about 50 µm diameter. Towards the edge of the FOV the contrast drops because of reduced angular overlap. The actual measured field of view was 40 µm in diameter. a (2) and b (2) show an inset of 10 x 10 µm^2, indicated as a square in a (1) and b (1). The smallest details can be seen in a (3) and b (3) which are 3 x 3 µm^2 insets of the area indicated by squares in a (2) and b (2), respectively.



Supplementary Figure 4. Raw projection of the chip sample measured with PyXL.
a shows the reconstructed illumination probe and **b** the reconstructed projection of the sample, perpendicular to the beam propagation direction. The reconstructions are plotted in a complex color scale, where the brightness corresponds to amplitude and the hue indicates relative phase-shift.



Supplementary Figure 5. A low resolution projection obtained from near-field ptychography with a 300 x 300 µm FOV.
a shows the reconstructed illumination probe and **b** a reconstruction projection of the sample. This low resolution scan was used for the 3D overview reconstruction shown in Fig. 2a. The reconstructions are plotted in a complex color scale, where the brightness corresponds to amplitude and the hue indicates relative phase-shift.



Supplementary Figure 6. Imaging geometry and angular sampling requirements.
a Laminography configuration with an angle θ between the beam propagation direction and the rotation axis. **b** Equivalent object-centric configuration where the beam propagation direction rotates around the object of thickness T. **c** Angular sampling requirements illustrated in Fourier domain. Each projection covers information over a thin slice in Fourier space.

Supplementary Table 1. Overview of the parameters of the X-ray measurements

	sample preparation	projection FOV	# projections	# diffraction patterns per projection	time per projection
PXCT	FIB-SEM, 10 µm diameter pillar	18 x 9 µm^2	914	328	90 s
PyXL overview	mechanical polishing of substrate to 20 µm thickness	50 x 26 µm^2	2872	485	67 s
PyXL		300 x 300 µm^2 in 25 patches each 70 x 70 µm^2	300	25x35	25x14 s