Coherent X-ray imaging

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X-ray microscopy of hydrated biological samples – especially in the so-called water window of 284-540 eV – is of tremendous interest for life sciences due to the high intrinsic contrast of organic matter with respect to the aqueous background and the higher penetration depth compared to transmission electron microscopy. We present X-ray microscopy of cryogenic samples using the coherence-based imaging technique called ptychography.

Ptychography combines previous coherent X-ray diffraction imaging (CXDI) approaches with a scanning scheme, thus providing the ability to image bigger samples, like whole cells or bacteria. We have performed soft X-ray ptychography experiments using our dedicated vacuum chamber HORST at different soft X-ray beamlines at the synchrotron source BESSY II in Berlin, demonstrating chemical contrast and resolutions down to 50 nm in test samples. After upgrading our vacuum chamber with a cryo-sample stage, we now present first results of soft x-ray ptychography of cryogenic samples. Cryo-fixation preserves the natural hydrated state of biological specimens and eliminates the need for any further preparation step, which might possibly alter the ultra-structure. By keeping the sample at temperatures around 120 K at all times, recrystallization of the amorphous water is avoided and the effects of radiation damage during the scans are minimized.