	Experiment title: Diffractive Imaging	**Experiment number:** MI-850
Beamline: ID10A	**Date of experiment:** from: Nov. 29, 2006 to: Dec. 05, 2006	**Date of report:** Aug. 31, 2007
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Report:

Diffractive imaging experiments were performed on lithographically prepared gold-structures with a size of approximately 3 μm and thickness of 150 nm. These gold structures were deposited on a free-standing Si_3N_4-membrane. A second sample was a cluster of 100 nm gold spheres. The aim was to record the far-field diffraction patterns of these samples as well as to test the vacuum chamber and all technical components of our setup.

The experiment was carried out at beamline ID10C in the following experimental environment. A secondary source was created by closing a pair of slits, positioned at a distance of 18.5 m upstream of the sample, to a size of about $50 \times 50\,\mu\mathrm{m}^2$. In this geometry the lateral coherence length at the sample position should be approximately 28 μm in horizontal and vertical direction. At a distance of about 4 m in front of the sample a Si 111 channel-cut monochromator was used to tune the energy of the x-rays to 7.98 keV. About 2 m downstream, a slit with highly polished roller blades, which was closed to a size of $10 \times 10\,\mu\mathrm{m}^2$, defined a coherent portion of the x-ray beam. Two further slit systems were installed in front of the sample in order remove the slit-scattering of the beam defining slit. The sample positioning was possible in all directions with an accuracy of tens of nanometers. The diffraction pattern was recorded using a directly illuminated CCD with 20 μm pixel size at a distance of 3.2 m after the sample. All technical components from the guard slits to the beam-stop were embedded in our vacuum chamber allowing for vacuum conditions down to 10^{-4} mbar. After installation of our setup and alignment of the optical components a number of diffraction patterns of the gold-structures were recorded.

Each of the diffraction patterns presented in Figs. 1-3 is the result of a series of exposures, i.e. 100 exposures using a 2 mm beam-stop as well 1000 exposures using a 1 mm or 0.5 mm beam-stop, respectively. The exposure time was varied such to not oversaturate the detector. This procedure was necessary to cover the large dynamic range of the diffraction pattern.

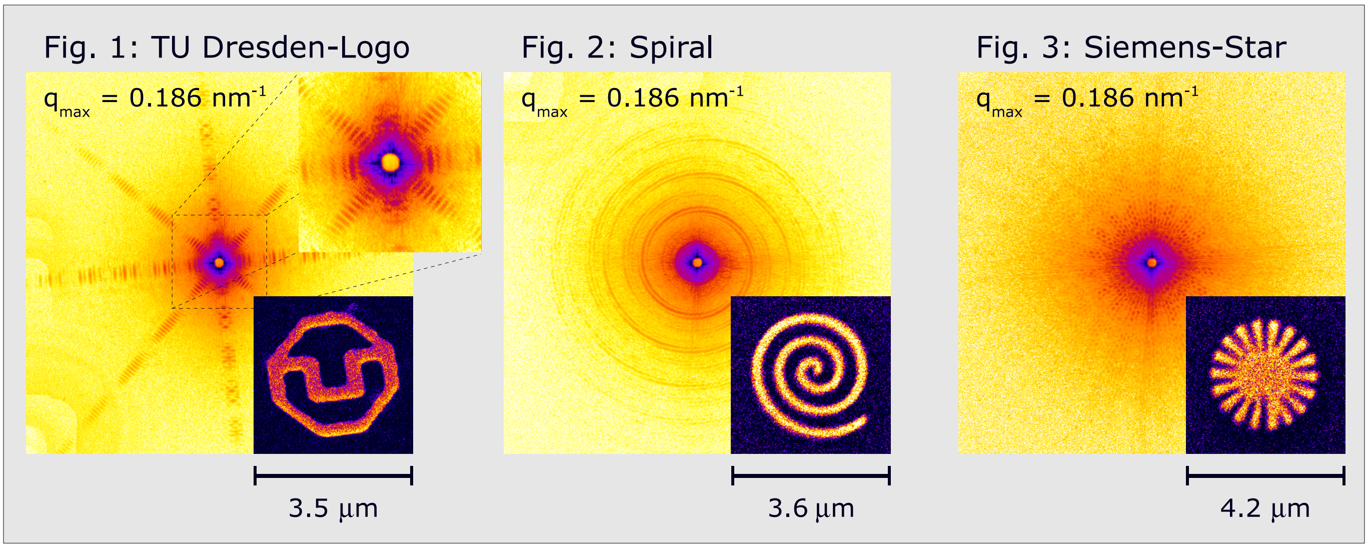
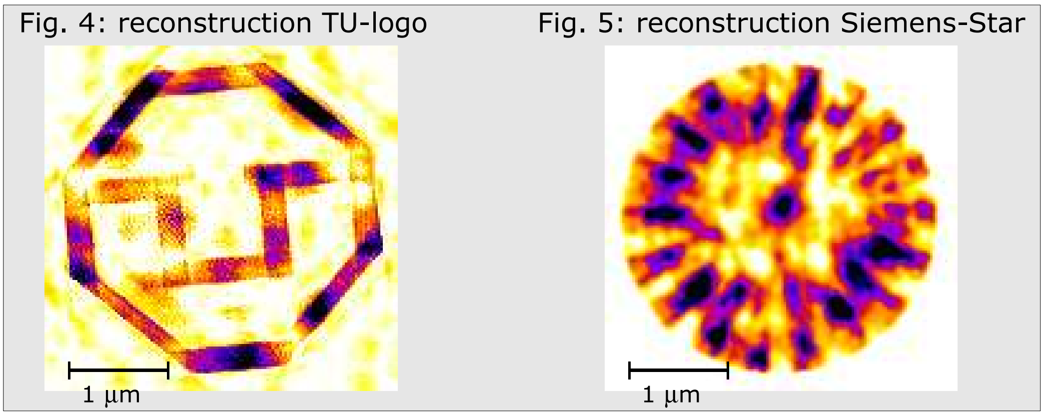


Fig. 1 shows that we could record a diffraction signal up to the edge of the detector giving a nominal resolution of 38 nm in x- and y-direction.



In Fig. 4 a successful reconstruction of the TU-Dresden-sample from the diffraction pattern presented in Fig. 1 is shown. The reconstruction was done using the Hybrid-Input-Output-algorithm. In this case the algorithm was able to recover the low frequency information that is lost in the central part of the pattern due to the slit scattering and a certain contamination with higher harmonic photons in that area (comp. inset in Fig. 1). Unfortunately, it turned out that this missing part of data is more severe for the reconstruction process in case of the other samples which is due to their shape and the variety of intrinsic symmetries of these objects (comp. the reconstruction of the Siemens-Star-sample, Fig. 5). Without providing additional low frequency information the algorithm is not able to find the global minimum. Though, certain sharp features of the object are represented well in the reconstruction result.