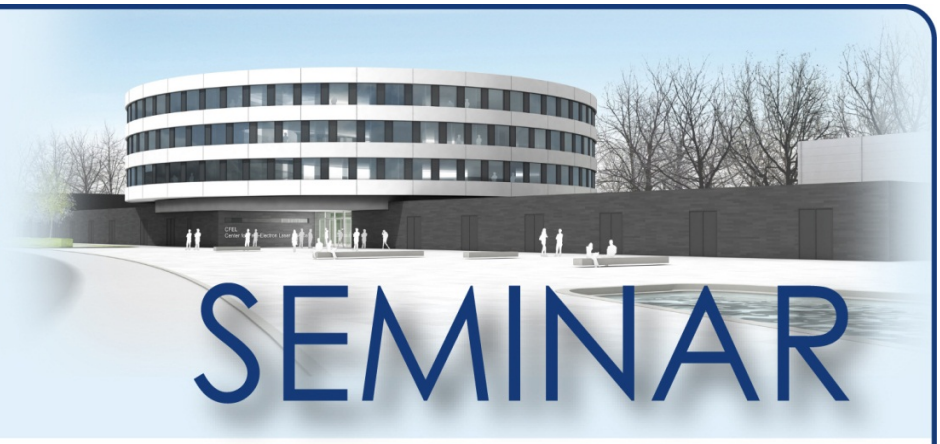
CFEL SCIENCE



SEMINAR

18th October 2011 - 10:00 a.m.

DESY building 49 - seminar room (108)

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X-Ray Optics

Spatial resolution of X-ray microscopes is primarily limited by the characteristics of the employed focusing optical elements. Today, Fresnel Zone Plates (ZPs) are widely used at synchrotron radiation sources, due to their capability of concentrating X-ray beams to spots of diameters in the tens of nanometers range. During this seminar, design, fabrication and characterization of high resolution ZPs for soft X-ray will be presented.

Since the ultimate resolution of a ZP is determined by the dimension of its outermost zone, hard X-ray optics imply aspect ratios exceeding 30 in the final structures. Strategies to fabricate such structures are usually classified as subtractive or additive, according to whether the absorber is subtracted (by dry etching) from an unstructured X-ray absorbing layer, or added into a patterned resist template (by electroplating). None of these two alternative strategies is exempt from problems. During the seminar a variation of structuring strategies to overcome both limitations will be proposed.

Phase diffractive optical elements, besides simple focusing, can perform new optical function in the range of X-ray energies. X-ray optic, which can generate two spots separated by few hundreds of nanometers with a specified phase difference between them will be illustrated. Multi-spot optics open up the possibility to perform differential interference contrast (DIC) X-ray microscopy, which can increase the image contrast for biological samples.

In the case of the multi-spot optics the phase object is sampled by two (or more) mutually coherent waves that have a lateral and a phase displacement. It is possible to change the sampling principle using a different type of diffractive optics as imaging elements. Spiral phase contrast microscopy has already demonstrated to produce edge contrast enhancement in visible light microscopy. The same technique used for visible light can be generalized to phase contrast X-ray microscopy by designing novel X-ray optics, called vortex, that generate a helical phase wavefront. During the seminar, X-ray vortex will be presented. For a quantitative characterization of the multi-spot and spiral phase optics, special 3D objects were fabricated. The 3D test objects were made by means of Focus Ion Beam technique and can be used as transmission mask in the X-ray microscope setup.

Host: Saša Bajt – FS-ML Group