# Fresnel zone plates for nanoARPES

P.Dudin(1), B.Rösner(2), J.Bosgra(2), M.Hoesch(1), C.David (2)

(1) Diamond Light Source, Didcot, UK

(2) Paul Scherrer Institute, Villigen, Switzerland

*Pavel.Dudin@diamond.ac.uk (***Pavel Dudin***)*

nanoARPES is a novel implementation of angle resolved photoemission spectroscopy, which provides spatial resolution by use of photons focused into a spot in the sub-micrometre. The design of FZPs for nanoARPES facilities is a complex balance defined by requirements of photoemission spectroscopy, best focusing as well as modern state of the art of zone plate manufacturing.

The zone plates for the nano ARPES facility at I05-ARPES beamline of Diamond Light Source have been designed jointly by Paul Scherer Institute and Diamond Light Source and manufactured at PSI.

The choice of parameters and manufacturing strategy of these FZP is dominated by the material of the support membrane. The standard silicon nitride membranes with thickness between 100 and 200 nm are disqualified by their extremely low transmission in the targeted photon energy range (50-200 eV). For this reason, we use extremely thin Si3N4 and gold membranes as substrates.

Another important aspect for the design of the optics arises from the extreme sensitivity of low-energy photoemission to scattered electric (and magnetic) fields, especially when high resolution in kinetic energy of electrons is desired. For this reason, the order sorting aperture, usually placed in close vicinity of the sample, has to be located at a rather large distance. We thus have to use zone plates with diameters of 1.5 mm and a central stop with diameter 0.75 mm.

The performance of the fabricated zone plates has been tested at the I05-ARPES beamline for spot size and efficiency in delivering photons to sample. The resulting measurement demonstrated the proper choice of membrane materials, providing sufficient flux for user experiments in spatially resolved ARPES. The determined spot sizes are also sufficiently small for user operation; however, it is remarkably larger than the standard diffraction limit. The presentation will give theoretical and experimental account of effects of enlarged central stop, spherical and chromatic aberrations as possible causes of increased spot size.