ESRF	**Experiment title:** Characterisation of Phase-type Transmission Zone Plates for X-ray Focussing in the 0.28-1.6keV range	**Experiment number**: MI-305
Beamline:	**Date of experiment**: from: 26/3/99 to: 28/3/99	**Date of report**: 11/08/99
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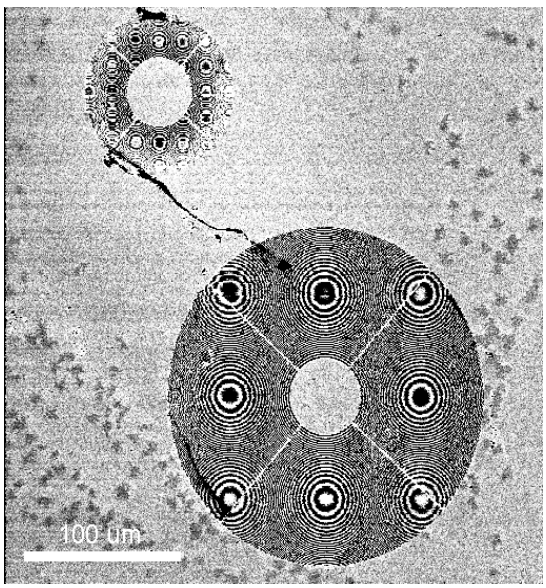
Report: The purpose of the experiment, was to characterize a number of Tungsten ZPs, in the region of 1-2 KeV. From our first beam time in November 98 we had already established a number of experimental procedures, which enabled us to rapidly characterize the two main quantities of interest in a ZP; namely, diffraction efficiency and resolution. We used similar techniques in this experiment, to test a number of larger ZPs, and the main results are shown in the following table.

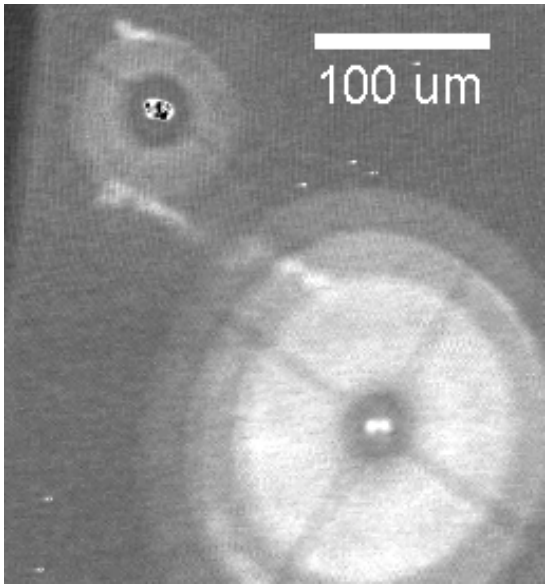
Dia. μm	Drn nm	thk nm	Ge %	E keV	Comments
92	90	360	9	3.0	| Array
200	200	360	11	3.0	| "
300	116	360	8.4	3.0	Single
184	92	700	2.1	3.0	Under etched
184	250	700	7	3.0	" "

Table 1. ZPs tested in March 1999, experiment MI305

For various technical reasons, we were unable to use X-rays below 3 KeV, and as a result, all tests were carried out at 3 KeV,as shown in the table. During the previous of ZP characterization (MI276), we identified a number of ZPs with Groove Efficiencies (Ge) of around 10% in the first diffraction order. Most of these ZPs had a diameter of 50-70 μm. By comparison, the ZPs tested in this experiment, had similar diffraction efficiencies, but considerably larger diameters, for example the 300 μm dia. 116 nm outermost zone width ZP, effectively producing 20 times more flux in the focal spot (because of the increased area of the ZP) . In addition, there is expected to be an increase of at least 50% in the diffraction efficiency at the energy they were designed for (~1.5 KeV). The X-ray micrograph of Fig.1, shows the ZP array at the top of the table, and was produced at the focal plane of the smaller ZP, which coincides with the plane of the 5th order focal spot of the larger ZP, which is clearly visible. This is another indication of the high quality of these Zone Plates.



SEM Image



X-ray image

The smallest of the two ZPs, with the highest resolution, was successfully used two months later, in the SXNM experiment (MI304). This enabled us for the first time to produce simultaneous X-ray, and AFM contact imaging of samples, at 3 KeV. A separate report for this experiment, is being prepared.

Finally, two thicker tungsten ZPs (700 nm), were also tested (end of table), and it was discovered that they were in fact under-etched, something that could only be determined from these tests. They have now been etched further, and we are hoping to re-test them later this year: they should hopefully yield efficiencies of 15% or more at 4-6 KeV