ESRF	**Experiment title:** Sub-micrometer X-ray beam production by a thin film waveguide	**Experiment number:** MI99
Beamline: ID13	**Date of experiment:** from: 22/3/96 to: 26/3/96	**Date of report:** 27/8/96
Shifts: 12	**Local contact(s):** C. Riekel	*Received at ESRF:*

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Report:

In previous experiments (see experimental reports MI50 and MI75) a thin film waveguide was used to produce a sub-micrometer beam. The outgoing beam was characterized both in dimension and in spatial distribution. Two coherent beams resulted to go out from the waveguide end, separated by the double of the inner reflection angle. The small dimension of the line-focus beam at the exit of the waveguide resulted to be 130 nm. In. both the mentioned experiments the beam incident on the waveguide was monochromatized by a Si(l11) monochromator. A flux of $5x10^8$ ph./sec was measured in a beam 0.130 x 600 µm. In this experiment we planned to improve the outgoing flux by using different kind of monochromator optics and to run some test diffraction experiments.

With the same waveguide used in the MI75 experiment, we replaced the, Si(111) monochromator with a Si/W multilayer monochromator with a baud-pass of about 10%. Both the reflectivity and the waveguided beam intensity as a function of the incidence angle showed a considerable broadening with respect to the same quantities measured with the crystal monochromator. A strong mode-mixing took therefore place. However the flux was in this case $8x10^9$, almost an order of magnitude higher than before.

The energy spectrum of the incoming beam and of the waveguide beam were measured with a Si crystal and the comparison showed that the two spectra were quite similar, suggesting that the whole energy spectrum was transmitted through the waveguide.

We then performed similar measurements with the Si crystal monochromator in combination with a focusing mirror. In. this case we obtained a flux of about $1x10^9$.

The efficiency, defined as the total exit flux over the input one, was 0.001 in the case of the unfocused beam, and 0.002 in the case of the focused beam. The efficiency is limited by the phase space acceptance of the waveguide, and by losses due to photoelectric absorption and to reflections at its walls. The results we obtained indicate that an improvement in efficiency could be obtained by optimizing the waveguide structure and by matching the incoming beam phase space with the wave guide phase space acceptance.

In order.to record diffraction patterns we had to reduce the background. A lead shielding was build around the waveguide. This shielding allowed recording of test diffraction patterns of Al_2O_3 , polyethilene and paraffine. Work is in progress to improve the background reduction through a more appropriate shielding.

The present results are the object of a paper submitted for publication to J. of Synchrotron Radiation.