ESRF	**Experiment title:** Testing of hard-X-ray mirrors using a shearing interferometer	**Experiment number:** MI-597
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Report:

In a previous experiment (MI-521, November 2001) a shearing interferometer for hard X rays had been used for the first time. The experiment had shown that the interferometer worked, that it showed no drift due to thermally or otherwise induced unwanted movement, and could be used for differential phase-contrast radiography (C. David *et al.*, APL **81** (2002) 3287).

The first goal of the present experiment was the **use of a simplified interferometer setup.** The setup in the earlier experiment had used a phase grating as an analyzer. Phase gratings for hard X rays are easier to manufacture than absorption gratings, but using a phase grating as the analyzer requires a Bragg crystal downstream of the grating to select the diffraction order before detection. This time, a newly-developed absorption analyzer grating made of gold was successfully used instead of the phase grating/crystal combination (Figure 1).

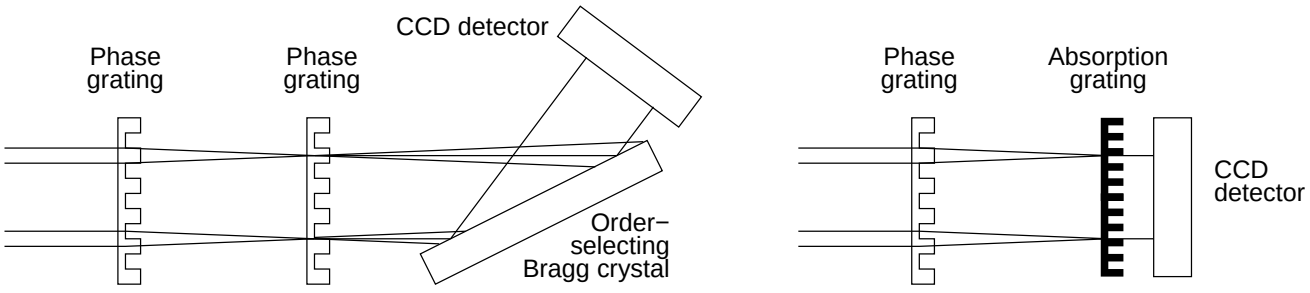

Figure 1: Previous *(left)* and improved *(right)* interferometer setup.

The sensitivity of the interferometer to distortions of the incident wavefront makes it suitable for the characterization of reflective optical elements *in situ* at the beamline, under the same conditions (heat load etc.) where the optics is generally used. The **demonstration of mirror-surface characterization with the interferometer** was therefore the second goal of the experiment reported here. Figure 2 shows the setup scheme. The interferometer analyzes the wavefront downstream of the mirror.

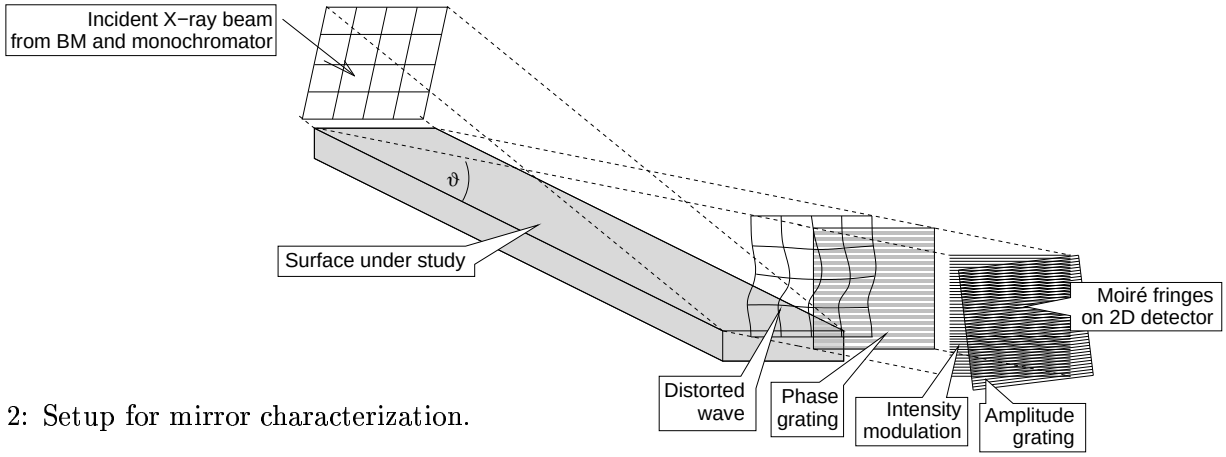

Figure 2: Setup for mirror characterization.

The experiments were carried out at 12.4 keV photon energy. The interferometer gratings had 1 and 2 μm pitch. The inter-grating distance was 86.5 mm. Different mirrors were tested both in multilayer and in total reflection. Figure 3 shows results for a tungsten/silicon multilayer mirror, including a simple fringe analysis. The longitudinal spatial resolution along the mirror surface is of the order of 0.5 mm. The reconstructed profile is plausible given that the mirror was provisionally mounted on a central support, which may have bent it around the center.

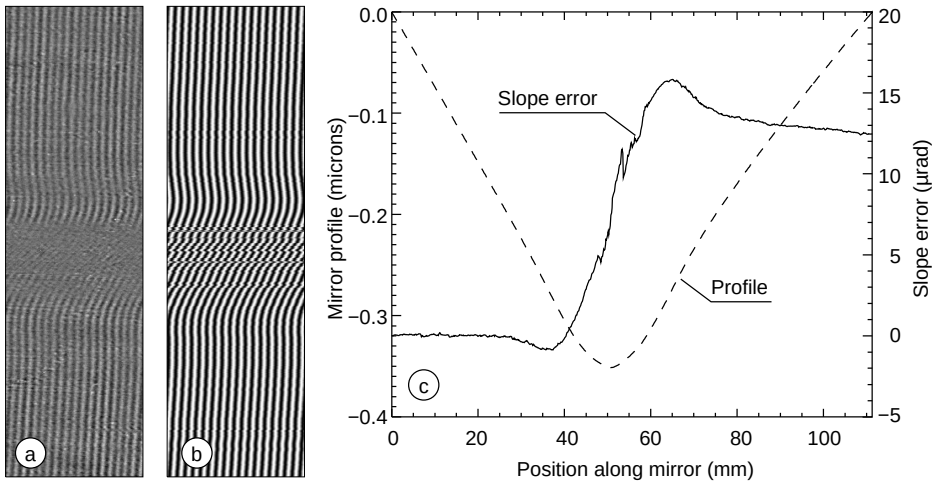

Figure 3: Results of characterization for a W/Si multilayer mirror. *(*a) Moiré fringes as observed on the detector. *(b)* After reduction and enhancement. *(c)* Reconstructed slope error and mirror profile.

The results show that both objectives of the experiments were fully met, i. e., firstly, the simplified interferometer setup showed good performance, and, secondly, this interferometer can be applied for the characterization of reflective X-ray optical surfaces.