Commissioning and first experiments at the Materials Science Beamline HARWI II

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As has been reported last year [1] GKSS, GFZ and DESY are reconstructing and rebuilding beamline W2 (HARWI) in a collaborative effort. In the course of the last year the reconstruction of the beamline and the experimental hall (building 25c) were finished, so that the optics hutch and the experimental hutches could be equipped with the most important components and instruments in order to test, study and use the first beam from the new insertion device [2]. Fig. 1 shows the current interior view of the experimental hall.

The optics hutch was equipped with a large monochromator tank with dimensions of 3 m in length, 2 m in width and 1 m in height (Fig. 2). Two different types of fixed–exit double–crystal monochromators will be mounted inside the tank with the option of easily changing between them without breaking the vacuum. The first one will be a Laue–type monochromator diffracting in the horizontal and providing photons between 60 and 250 keV within a beam size of 10 x 10 mm². The second one will provide a beam up to 70 mm in width, 10 mm in height and photon energies down to 20 keV. This monochromator will diffract in the vertical (Fig. 3). For the first tests only the horizontal monochromator was preliminarily installed in the tank, equipped with two annealed Si (111) crystals (FWHM: ≈ 6°) and operated at 82 keV. The tank is connected to the vacuum tube of the beamline and can be evacuated to below 10⁻⁶ mbar.

In order to protect the downstream equipment against the ‘white’ beam a massive beamstop was installed behind the tank (Fig. 4). It consists of a water–cooled copper block, which is designed to
handle up to 12 kW heat load. Behind the copper, a tungsten block of 100 mm thickness absorbs the high–energy fraction of the wiggler spectrum. The beamstop has a small pinhole of 0.7 mm diameter to provide a narrow ‘white’ beam for experiments. Additionally, two channels for the monochromatic beams are present. Fig. 5 shows the flange at the rear end of the device. The monochromatic
channels are sealed with capton foil, whereas for the ‘white’ beam pinhole is covered by a glassy carbon plate of 0.5 mm thickness. The beamstop is evacuated via the monochromator tank and can be aligned using small tilt movements via remote control.

Figure 4: The beamstop for the ‘white’ beam.

The optics hutch equipment is completed by a beamshutter. Between the beamshutter and the beamstop there is still about 1 m remaining free beam path for a future installation of various additional devices, e.g. beam monitors and cameras, slit systems, add–on shutters and beam filters etc. In the first experimental hutch two pits will allow to easily change between various experiments. In the first pit a large materials science diffractometer will be installed next year. The second pit (downstream) has already been equipped with two tables for heavy loads up to 3 tons. Both tables of 3 m in length and 1.4 m in width can be independently lifted into the beam (Figs. 6 and 7). On the upstream table a Eulerian cradle and an image plate scanner were preliminarily mounted for the first diffraction test experiments. As soon as the diffractometer is installed, this table will be free for other experiments. The second table is dedicated for tomography setups and measurements. A new tomography apparatus and a setup for a combined diffraction and tomography experiments is under construction and will replace the existing setup at a later stage. First test experiments have already been performed, namely texture experiments on various samples, a strain analysis and a couple of tomography measurements. Preliminary results showed that the data quality measured at the new HARWI II beamline is already comparable to that of the existing high–energy beamline BW5, although due to limited time no optimization of the optics and the instruments could be performed so far. Thus, the first months of the next year will be needed for commissioning, optimization and characterization as well as further test experiments. After installation of the new materials science diffractometer and a new tomography setup, full user mode is expected in the second half of 2006.
Figure 5: Rear end of the beamstop.

Figure 6: Preliminary diffractometer setup on the first experiment table.
Figure 7: Tomography setup on the second experiment table.

References