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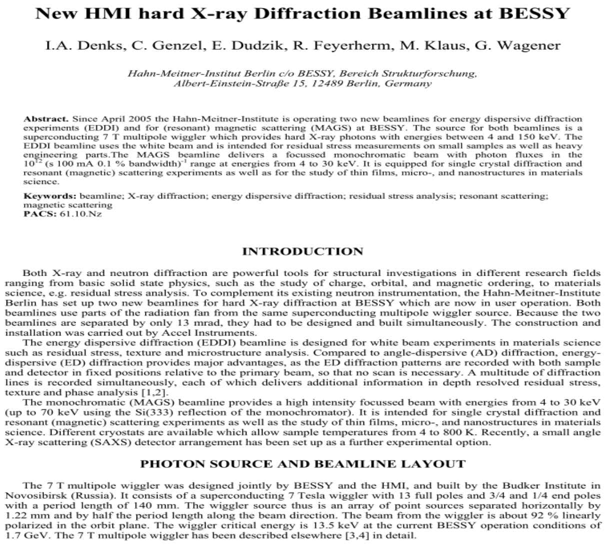

New HMI hard X-ray Diffraction Beamlines at BESSY

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Abstract. Since April 2005 the Hahn-Meitner-Institute is operating two new beamlines for energy dispersive diffraction experiments (EDDI) and for (resonant) magnetic scattering (MAGS) at BESSY. The source for both beamlines is a superconducting 7 T multipole wiggler which provides hard X-ray photons with energies between 4 and 150 keV. The EDDI beamline uses the white beam and is intended for residual stress measurements on small samples as well as heavy engineering parts.The MAGS beamline delivers a focussed monochromatic beam with photon fluxes in the 10^{12} (s 100 mA 0.1 % bandwidth)$^{-1}$ range at energies from 4 to 30 keV. It is equipped for single crystal diffraction and resonant (magnetic) scattering experiments as well as for the study of thin films, micro-, and nanostructures in materials science.

Keywords: beamline; X-ray diffraction; energy dispersive diffraction; residual stress analysis; resonant scattering; magnetic scattering
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INTRODUCTION

Both X-ray and neutron diffraction are powerful tools for structural investigations in different research fields ranging from basic solid state physics, such as the study of charge, orbital, and magnetic ordering, to materials science, e.g. residual stress analysis. To complement its existing neutron instrumentation, the Hahn-Meitner-Institute Berlin has set up two new beamlines for hard X-ray diffraction at BESSY which are now in user operation. Both beamlines use parts of the radiation fan from the same superconducting multipole wiggler source. Because the two beamlines are separated by only 13 mrad, they had to be designed and built simultaneously. The construction and installation was carried out by Accel Instruments.

The energy dispersive diffraction (EDDI) beamline is designed for white beam experiments in materials science such as residual stress, texture and microstructure analysis. Compared to angle-dispersive (AD) diffraction, energy-dispersive (ED) diffraction provides major advantages, as the ED diffraction patterns are recorded with both sample and detector in fixed positions relative to the primary beam, so that no scan is necessary. A multitude of diffraction lines is recorded simultaneously, each of which delivers additional information in depth resolved residual stress, texture and phase analysis [1,2].

The monochromatic (MAGS) beamline provides a high intensity focussed beam with energies from 4 to 30 keV (up to 70 keV using the Si(333) reflection of the monochromator). It is intended for single crystal diffraction and resonant (magnetic) scattering experiments as well as the study of thin films, micro-, and nanostructures in materials science. Different cryostats are available which allow sample temperatures from 4 to 800 K. Recently, a small angle X-ray scattering (SAXS) detector arrangement has been set up as a further experimental option.

PHOTON SOURCE AND BEAMLINE LAYOUT

The 7 T multipole wiggler was designed jointly by BESSY and the HMI, and built by the Budker Institute in Novosibirsk (Russia). It consists of a superconducting 7 Tesla wiggler with 13 full poles and 3/4 and 1/4 end poles with a period length of 140 mm. The wiggler source thus is an array of point sources separated horizontally by 1.22 mm and by half the period length along the beam direction. The beam from the wiggler is about 92 % linearly polarized in the orbit plane. The wiggler critical energy is 13.5 keV at the current BESSY operation conditions of 1.7 GeV. The 7 T multipole wiggler has been described elsewhere [3,4] in detail.

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