In this contribution, we will be providing an insight into current developments of multilayer optics for X-ray analytics in the lab and at synchrotrons. We explain the manufacturing process, summarize the different types of optics and give some examples of typical applications which benefit from the new possibilities, especially in combination with modern microfocus X-ray sources, novel metal-jet anode X-ray sources, mini-synchrotrons, beamlines and FELs.

The optics consist of bent substrates with shape tolerances below 100nm. By using sputtering technology we deposit multilayers upon these substrates with several hundreds of layer pairs and single layer thicknesses in the nanometer range. To ensure high-quality X-ray optics we fabricate the multilayers with lateral thickness gradients within ± 1% deviation of the ideal shape. We use optical profilometry in order to characterize the shape and X-ray reflectometry for the characterization of the multilayer thickness distribution both laterally and as in-depth. The microstructure is investigated by transmission electron microscopy.

Modern deposition technology allows for the reproducible production of high quality multilayer mirrors with smaller d-spacing. Thus, in combination with the latest generation of microfocus sealed tubes it is possible to provide new high-performance X-ray sources for shorter wavelengths. We will be presenting selected results on the use of our new air-cooled high-brilliance X-ray source IμS for Mo-Kα and Ag-Kα radiation in small molecule and high-pressure crystallography.

For home-lab sources our so-called Montel Optics focus or collimate the beam in 2D with a very high flux density and an adequate divergence directly at the sample position. However, synchrotrons need a higher quality of the shaped substrates. We designed and produced first Montel Optics of the third generation especially for an analyzer system at inelastic scattering beamlines.

Furthermore, we developed special multi-stripe optics for Double Crystal Multilayer Monochromators (DCMM) which are used at tomography beamlines in a wide range of photon energies (10-45keV).

In special mini-synchrotrons our longest multilayers of 40 cm in length are used. We will be showing first results.

In addition we will be presenting our total reflection optics for which we developed a large variety of ceramic and metallic layers on large substrates with a length of up to 150cm.

Keywords: X-ray optics, multilayer, source

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The new in situ screening facility at the MX-beamlines BL14.1 at BESSY II of the Helmholtz-Zentrum Berlin (HZB)

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In spite of large scale automation and an on-going miniaturisation process in high-throughput protein crystallisation, human efforts are required to pick individual crystalline specimens from 96-well crystallization plates and to characterize them. In addition, not optimal cryogenic stabilization solutions often mask the diffraction properties of macromolecular crystals. An alternative to this conventional approach is to expose macromolecular crystals or possible crystalline material grown in crystallisation plates directly in the X-ray beam [1]. We present the implementation of an *in situ* crystal screening platform [2] using the CATS sample changer and a MD2 microdiffractometer at the HZB-MX-beamline 14.1 [3].

The hardware implementation consists of a six-axis robotic arm and a dedicated tool for gripping crystallisation plates. This mode of operation is alternative to the normally used transfer of cryo-cooled samples. Every object within the plate can be precisely positioned in front of the X-ray beam. The robot arm acts as the omega-rotation axis during diffraction data collection.

Different proteins were subjected to standard sparse-matrix crystallisation screens in three different plate types and exposed in the beam using the robot. The results show an unambiguous identification of crystalline and non-crystalline objects. The diffraction images were successfully auto-indexed and important metrics of the crystal system could be determined. Furthermore, in some cases diffraction data sets could be collected to a high completeness.

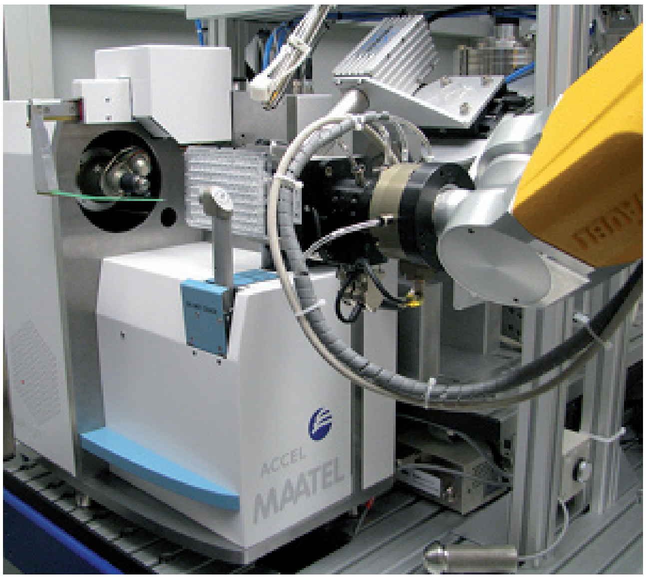

Fig. 1. A 96-well plate mounted ready for X-ray exposure

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Keywords: in-situ, bio-macromolecule, synchrotron

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A flexible macromolecular crystallography beamline at the alba synchrotron

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ALBA is a third generation 3-GeV storage ring built near Barcelona and the Universitat Autònoma de Barcelona. Out of the seven first-phase beamlines, XALOC (BL13) is dedicated to Macromolecular Crystallography (MX). The photon source of this beamline is a 2-m long in-vacuum undulator with a period of 21.6 mm and a nominal minimum gap of 5.5 mm. This device has been optimized to deliver the highest flux at the Se K-edge while keeping full tunability in the 5-21 keV range. The optics consists in a cryogenically cooled Si(111) channel-cut crystal monochromator and a pair of mirrors in a Kirkpatrick-Baez or orthogonal configuration. The End Station