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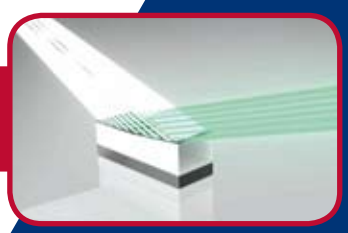
Göbel Mirrors

Optics for X-ray Diffraction

XRD

- More than 10^8 photons/sec with sealed tubes
- For parallel , focusing and divergent beam geometries
- For Cr, Fe, Co, Cu, Mo, Ag, ... radiation
- Optics of varying lengths and focal distances
- 3rd Generation for highest resolution
  - optics with slope errors below 1 arcsec
  - lowest divergence and best parallel beam
  - best monochromatization

XRD High performance with Göbel Mirrors



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Göbel Mirrors: Optics for X-ray Diffraction

Incoatec offers various types of optics for X-ray diffraction (XRD) devices. Nowadays the most widespread optics for XRD are the so-called "Göbel Mirrors". Göbel Mirrors (GM) convert the divergent X-ray beam coming from an X-ray tube into a parallel beam and additionally monochromatize it. A Göbel Mirror consists of multilayers with laterally graded thickness, deposited with an accuracy below 1 % onto a parabolic surface and typically has a divergence of 0.5 mrad; other divergencies are available on request.

X-ray instruments equipped with a Göbel Mirror show dramatically improved performances in various types of measurements compared with instruments without this mirror. A typical application for GM's is X-ray Reflectometry (XRR). Figure 1 shows the comparison between measurements with and without the use of a GM: The intensity achieved with a GM is more than 10 times higher, an important aspect for more detailed fitting procedures.

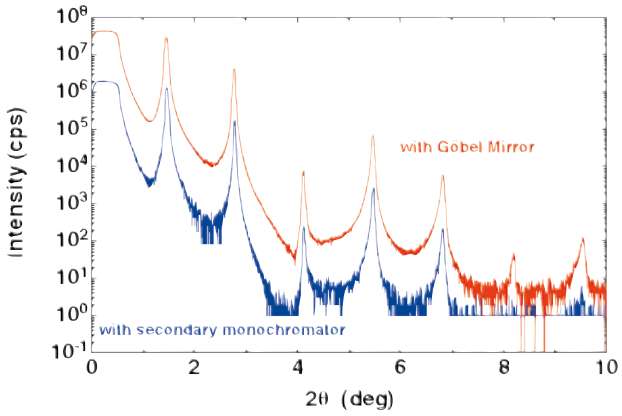

Fig. 1: XRR Measurement of a V-C multilayer sample with a Göbel Mirror and a comparable system without such an optic.

A significant intensity gain was also achieved using our X-ray mirrors for measurements in High Resolution Diffractometry (HRXRD). This was made possible by the development of the so-called 3rd generation Göbel Mirrors. These consist of an ultra-precise prepolished parabolical form (with slope errors down to 1 arcsec rms) with an ultra-precise multilayer coating. The intensity achieved by directing a beam from a 3rd generation GM into channel-cut monochromators was 16 times higher in comparison to a set-up without a GM.

Another possible application is combining primary and secondary Göbel Mirrors with a point detector. With this type of set-up even fluorescence radiation from the sample can be suppressed enabling investigations with Cu-radiation of, for example, samples containing iron. Together with the standard Parallel Beam Göbel Mirror, Incoatec also produces both Convergent Beam as well as Divergent Beam Göbel Mirrors. For some applications for example in powder diffractometry a parallel beam is not allways the best choice. Better results are achieved with a slightly divergent Göbel Mirror due to an increase in intensity. The product range includes optics for various types of tubes. Table 1 gives an overview on Göbel Mirrors produced by Incoatec GmbH. An existing system can be upgraded with Göbel Mirrors in specially designed optics housings.

Optics type	GM 2nd gen.	GM 3rd gen.	GM Powder
wavelength	Cr, Fe, Co, Cu, Mo, Ag	Cu, Mo, ...	Cu
beam shaping	1D par or foc	1D par	1D div
length (mm)	40 - 60	40 - 60	40 - 60
substrate	Si, slope error < 0.003°	Quartz, slope error < 0.001°	Si, slope error < 0.003°

Tab. 1: Different types of 1D multilayer optics for diffractometry

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