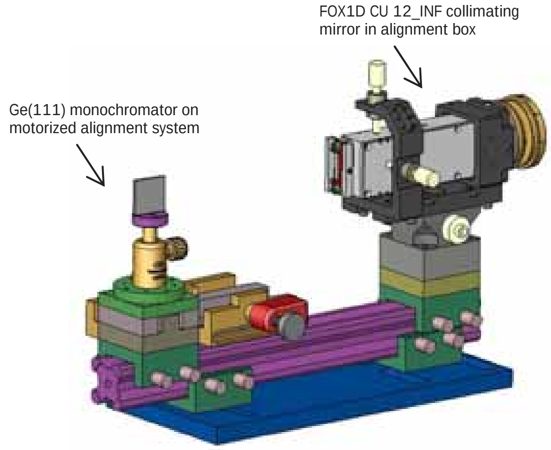
Xenocs Double bounce hybrid optics for high resolution reflectivity and coplanar diffraction

High resolution reflectivity and coplanar high-resolution diffraction both require an optimization of the resolution solely in one dimension. Reflectivity in particular is thus the typical application for line focus geometry and 1-dimensional collimating mirrors. For reflectivity studies with a high resolution demand (e.g. for highly perfect thick films or multilayers), as well as for diffraction studies the XENOCS FOX1D Hybrid optic (see figure 1), combining a parbolic multilayer mirror and an asymetric Ge crystal, offers further advantages with respect to the use of a simple multilayer optic or of a simple monochormator.



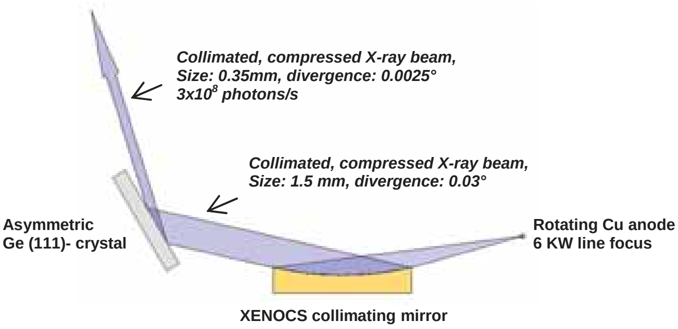


Figure 1: Hybrid system based on a FOX1D CU 12_INF collimating multilayer optics combined with a Ge(111) crystal

All experiments presented in this application note were performed at the SP2M Laboratory (DRFMC/ CEA) in Grenoble, France where this hybrid system was recently installed.

(Data Courtesy Dr. Vincent Favre-Nicolin).

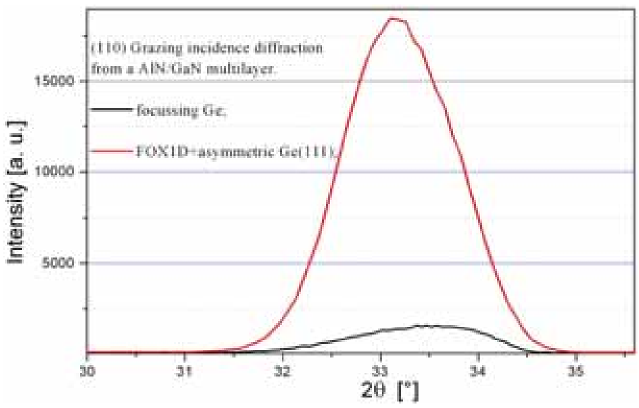


Figure 3 : Grazing incidence diffraction from a AlN/GaN multilayer. The compressed and parallel beam from the Xenocs hybrid optic supplies a well-defined angle of incidence. With the incident photons concentrated close to the critical angle, the diffracted intensity (red line) is increased by a factor of 8.

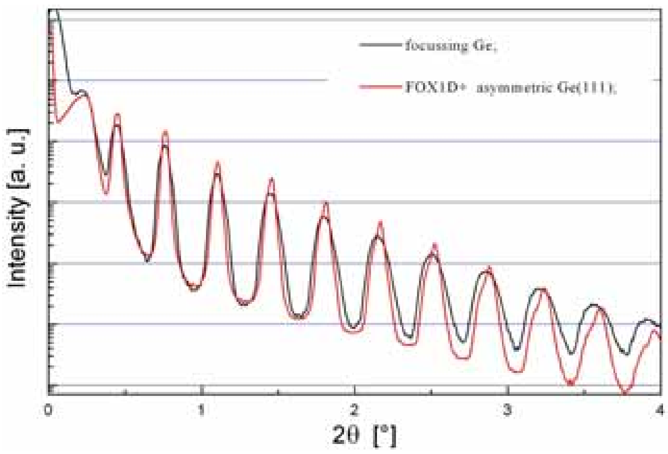


Figure 2: Reflectivity of an epitaxial layer. The black curve refers to a setting using a focussing Ge-monochromator. The Xenocs hybrid optic yields the red curve. For comparable intensities, the resolution is substantially increased.

Conclusion:

- **Angular resolution improvement by more than one order of magnitude:** With 0.0025° beam divergence versus 0.03° for pure mirror usage. The well defined angle of incidence allows a proper control of diffraction conditions at the critical angle.
- **Compression of the beam size by a factor of 4:** The rejection of the intensity by a crystal monochromator is partially compensated by reducing the beam size. This increases the useful part of the beam for low angles of incidence. At $\theta = 2.1°$, the beam is already fully used on a sample of 10 mm in size.
- **Substantial increase of the monochromaticity:** The dispersive combination of both optical elements allows leads to a $K\alpha_I / K\alpha_{II}$ ratio of 35.

Xenocs
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info@xenocs.com - www.xenocs.com
19 Rue F. Blumet - 38360 Sassenage (France)
Phone : +33 4 76 26 95 40 Fax : +33 4 76 26 95 49
Xenocs - A spin off company from Institut Laue Langevin