

Bruker **AXS**



DIFFRACTION SOLUTIONS

D2 CRYSO

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Crystal Orientation Out of the Box

Easy and Right on the Process

Single crystal growth and processing on an industrial scale is a prerequisite for the production of semiconductor wafers, optical elements, and monochromator or analyzer crystals. An essential process step and quality criterion in this industry is the determination of the orientation of the crystal lattice. In fact, during the manufacturing process, crystal lattice orientation must be very closely controlled. In many cases X-ray diffraction (XRD) is the only non-destructive method that can accomplish this task.

The D2 CRYSO is a tabletop X-ray diffraction instrument that fits both the R&D and QC requirements of single crystal manufacturing. Using energy-dispersive diffraction technology (EDXRD), the D2 CRYSO offers low cost of ownership, easy operation, and fabrication at-line. Furthermore, its flexibility enables you to adjust and apply the D2 CRYSO as new needs and processes arise.

Designed for fast, accurate determination of orthogonal surface orientation, the D2 CRYSO analyzes single crystals of all sizes, tiny to large (fig. 1). Its EDXRD technology eliminates the need for the complex mechanics, high power consumption and water cooling required by traditional instruments. The D2 CRYSO offers numerous benefits that make it a cost-effective instrument:

- Completely enclosed beam path for absolutely radiation-safe operation
- Tabletop design requiring no consumables – virtually maintenance-free
- Applicable to a wide range of single-crystal materials – from wafers up to 38.5 cm in diameter to ingots up to 35 kg in weight
- High-performance XFlash® technology inside for the ultimate in analytical speed and accuracy
- Automated operation for routine work as well as production and quality control



Figure 1. D2 CRYSO close-up showing open lid and crystal in measurement position.

Energy-dispersive X-ray Diffraction

Energy-dispersive X-ray Diffraction (EDXRD) is a powerful method for laboratory and industrial use. It allows determination of crystal orientation both quickly and with high accuracy and precision.

If a 'white' X-ray beam hits a single crystal, the Laue condition defines the direction of a possible diffracted beam (fig. 2). An energy-dispersive detector placed in the path of the diffracted beam detects the energy, and thus the wavelength, of the diffracted X-rays. By variation of the sample rotation around the crystal surface axis (or crystal surface normal) one can determine the direction of the corresponding crystallographic axis. Once two crystallographic directions are determined, the orientation of the crystal with respect to axes normal and parallel to the surface can be calculated.

Fast and Accurate Results

Operating the D2 CRYSO is easy: simply place the crystal on the flat and horizontal specimen disc and close the lid. A series of measurements of spectra at fixed diffraction angles but different azimuth settings is performed, recording peaks at characteristic energy values.

Software on the D2 CRYSO automatically models the energy characteristics and refines the main orientation. By driving the XFlash[®] detector to a higher diffraction angle, an additional crystallographic direction is investigated and the full crystal orientation, including the 'flat' orientation, can be calculated (fig. 3).

Push the button and a report is created. The flat direction can be indicated by an optional marker before the specimen is removed.

Flexibility

Simplicity and flexibility are the most striking features of the D2 CRYSO. A number of optional accessories allows the mounting of very tiny to very large samples. Sample mounts can even be integrated with crystal machining tools so that wafers are cut at the exact orientation required.

The software includes a database of crystal structures, allowing a straight-forward analysis. Dedicated analysis strategies can be developed running the D2 CRYSO in the expert mode. Once verified, those methods can easily be added to the database for later push-button operation.

The D2 CRYSO Diffraction Solution is a future-safe investment that enables you to non-destructively determine orientations of all kinds of crystals that may come along.

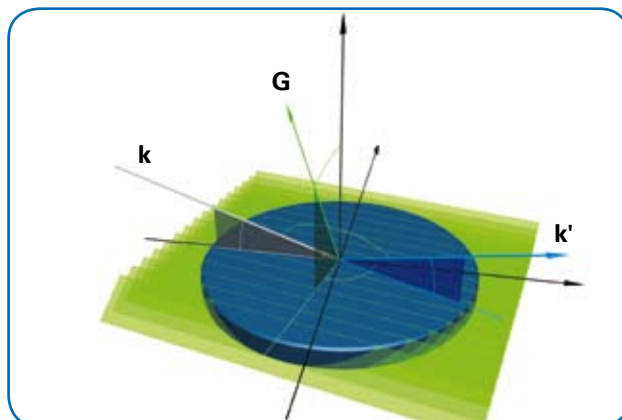


Figure 2. General measuring principle of the D2 CRYSO. The primary 'white' beam (grey) impinges on the single crystal sample with lattice planes oriented at an angle with respect to the surface of the crystal. The direction of the diffracted 'monochromatic' beam (blue) off the scattering planes (green) is defined by the Laue condition, $\mathbf{k} - \mathbf{k}' = \mathbf{G}$, with \mathbf{k} and \mathbf{k}' are the wave vectors of the incident and diffracted beam, and \mathbf{G} is a reciprocal space vector.

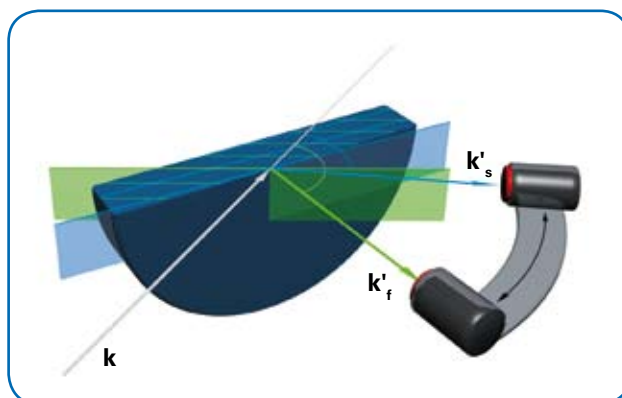


Figure 3. Measuring principle of the D2 CRYSO: the primary beam \mathbf{k} is diffracted by lattice planes (blue, \mathbf{k}'_s) for the determination of the surface orientation. The flat orientation is determined by diffraction on lattice planes with large inclination (green, \mathbf{k}'_f).

Technical Data	
X-ray tube	Rhodium, max. 50 W at 35 kV, air cooled
X-ray optic	500 micron mono-capillary
Detector	XFlash® Silicon Drift Detector (SDD), Peltier cooled 30 mm ² active area < 150 eV energy resolution at Mn K α
Analytical parameters	
Allowed off-angle	$\leq 5^\circ$ ($\leq 37^\circ$)
Achievable accuracy	
Main orientation	$< 0.02^\circ$
Flat orientation	$\leq 0.2^\circ$
Sample dimensions	
Weight	max. 35 kg
Diameter	max. 385 mm
Height	max. 140 mm (210 mm optional)
Instrument	
Exterior size (H x W x D)	500 x 560 x 540 mm (20" x 22.5" x 21.6")
Weight	60 kg
Power consumption	150 W

Notes: Cooling water supply not required.
Installation in a controlled-radiation area not required.

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