Delta Technologies Int'l

Ingot Orientation for wire saw cutting
GM.WS Series
X-ray goniometer

The GM.WS series X-ray orientation units are specifically dedicated to the accurate orientation of small to large size ingots before cutting on a wire saw. (Also refer to manufacturing program leaflet for general information).

The proposed equipment and method call for a strictly crystallographic and mathematical process which takes the initial crystal disorientation** into account.

By using this equipment, the ingot orientation is measured in such a way that the **ingot can remain horizontal** on the wire saw work holder for further slicing process, taking both the ingot own disorientation resulting from crystal pulling and OD grinding and a specified "off-orientation" if any, into consideration.
In other words the equipment automatically targets the resulting angle at which the ingot can be sliced without requiring a vertical tilting.

Depending of the type of wire saw, several gluing possibilities can be applied. Dedicated gluing equipment with orientation control is available.

Photograph is not contractual. Actual design for operation with flat panel monitor and small size keyboard

** Process development with the scientific assistance of Mr Georges Bravic, at the Crystallography Research Laboratory of the University of Bordeaux, France.

SPECIFICATION

X-ray generator
- Output voltage : 30 kV - DC
- Maximum rating : 30 mA
- X-ray tube : copper target, water cooled
- Apparent focus : linear
- Mains : 220 V 50/60 Hz, 1-phase, 10 A
- Water supply : 3.5 bar.

Detection unit
- Proportional counter linked to a special integrator with peak amplifier. High detection accuracy.
- Detector voltage: adjustable 1000 - 1750 V
- Detector setting (2θ) : < 0° to approx. 100°

Goniometer features
- Acceptable load : up to 100 Kg, depending on configuration (models of various capacities)
- Fine rotation control on the whole rotation range
- High resolution incremental encoder is directly linked to goniometer shaft, avoiding any backlash

Ingot holder mechanism
- Ingot holding : 2 heavy duty rubber coated rolls.
- Horizontal table : mounted on precision slides. Ingot is maintained in permanent contact with X-ray beam focusing point. Contact force is adjustable.

GM.WS ingot dia. 100-300 mm, length up to 300 mm
GM.WS/450: ingot length up to 450mm or dia. 300 x L 300 mm
GM.WS/450-300: up to dia. 300 mm, length 450mm
Other WS models not listed above are available

Range of applications
- Ingot orientation prior to wire saw cutting
- Ingot axis orientation measurement
- Determination of (110) directions on (111) ingots **
- Orientation measurement of wafer face

** Specific information on request.

Performance
- Accuracy of goniometric measurements : +/- 0.01°
- Ingot orientation accuracy : +/- 0.05° (+/- 3')
- Goniometer rotation range (θ) : < 0° to approx. 70°

Specific devices
- Dedicated tool allows ingot flat or notch to be placed at a reference position (initial datum)
- The same device is used for scribing ingot face after the orientation is performed

Software
User friendly operator interface provides easy and safe operation.
- Zero reset of relative measurement display with respect to the crystal planes (Manual mode)
- Zero reset of ingot rotation display
- Goniometer automatic re-calibration at start-up
- Storage of measured Data and others on daily file. Generation of process result files at each process cycle for host computer (optional)

A demo software with operation manual is available on request. Please ask for it or for a demonstration at your site by our agent or distributor.

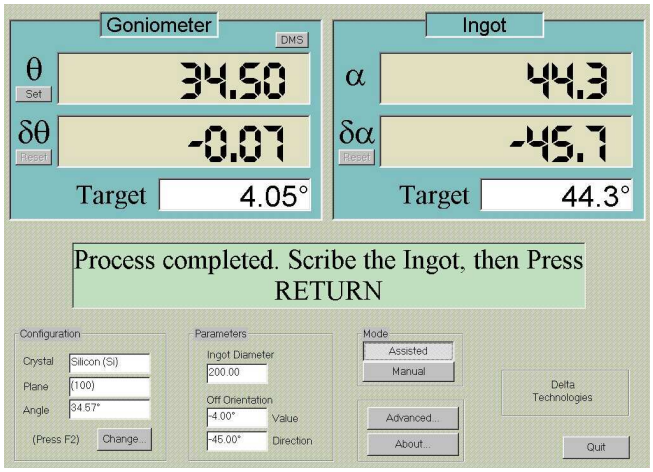
Safeties and protections

The equipment offers both maximum protection and easy operation.

- Electromagnetic rotary shutter is controlled by a non latching foot switch.
- Shutter interlock switch is actuated by the ingot in measuring position.
- Green control light : shutter closed
- Red control light : shutter open
- “X-ray ON" warning light indicates the X-ray tube is energized
- Automatic shut off in case of warning lamp failure
- Shielding and screens stop direct or scattered radiation.

Measuring system and monitor display

The measurement of goniometer rotation (about OY axis) and ingot rotation (about OZ axis) are performed through incremental encoders and a dedicated acquisition board located in a PC.



Input data :

- Ingot diameter
- Crystal plane
- Specified off orientation
- Off orientation direction

Measured data :

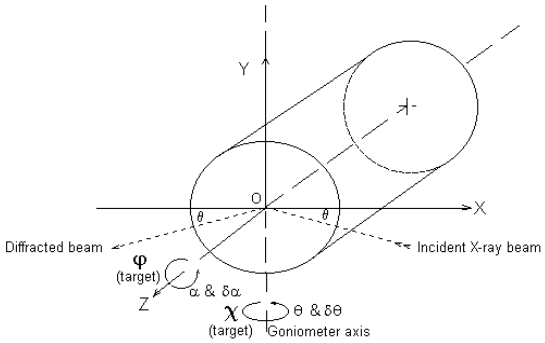
- Goniometer angle (θ) in decimal degrees (0.01°) or in deg. min. sec.
- Relative measurement (δθ) with respect to selected angle, in decimal degrees & deg. min. sec. as above.
- Ingot rotation about its OZ axis (α).

Calculated data (targets) :

- Ingot cutting angle (rotation about OY vertical axis (χ)).
- Ingot rotation angle about its OZ horizontal axis (φ)

Process commands and indicators :

A succession of prompts and indications guide the operator throughout the process.
At “key” steps, locks inhibit program progress until proper action has been taken.



Operation sequence

- Place the ingot on the rolls.
- Check or fill in the data input fields.
- Place ingot flat or notch at datum position, using the specific alignment tool.
- Proceed to ingot axis orientation measurement
- Enable the calculation of the targets
- Rotate ingot (α) until the counter reaches the target.

After orientation process

- Scribe the ingot face with a vertical line, using the alignment tool. Ingot is ready for being glued. The χ value (rotation about OY) is the only one to take into consideration. The ingot is to be oriented at this target either on the saw work holder at time of gluing or on the saw itself after it has been glued parallel to the saw work holder.

Accessories and other goniometer models

- Orientation & gluing system of ingot on saw work holder
- GM series goniometers for all types of wafer orientation measurements.
- GM.SI series goniometers for flat & notch orientation process and measurement.
- Customized design and special accessories available on all goniometer models

Double station x-ray goniometer GMWS450/300 – GMR1D PC