norwegian crystals

Product Specification

P-type - Dia 210 mm/FTF 156.75 mm - Mono blocks

PT18-210-2B

1 Crystal, chemical and material properties

Property	Specification	Control frequenzy	Measuring Method	References
Crystal Growing method	CZ	-	-	-
Crystal Structure	Mono-crystalline	-	-	-
Crystal Orientation	<1-0-0> +/- 3°	-	-	-
Conductivity Type	P-type	Each block	-	-
Dopant	Boron	-	-	-
Oxygen Concentration[1]	≤ 9.0 x 10^{17} atoms/cm³ [≤ 18.0 ppma]	Each mother ingot - center value, seed and tail	FTIR	(new) ASTM F121 - 83
Carbon Concentration[2]	≤ 1.0 x 10^{17} atoms/cm³ [≤ 2.0 ppma]	Each mother ingot - center value, seed and tail	FTIR	ASTM F1391-93a

2 Electrical and Chemical properties

Property	Specification	Control frequenzy	Measuring Method	References
Specific Resistivity[3]	1.0 - 2.5 Ohmcm	Each mother ingot - center value, seed and tail	4-point probe	ASTM F84
Bulk Lifetime[4]	≥ 100 µs	Each mother ingot - surface value, seed and tail	Sinton	QSS
Defects[5]	No slip lines	Each mother ingot - seed and tail	Visual and PL-camera	-

3 Geometry

Property	Specification	Control frequenzy	Measuring Method	References
Ingot Diagonal	210 mm +/- 0.25 mm	100% - All blocks	Caliper and Vision system	Intego ORION
Ingot Dimensions	156.75 mm +/- 0.20 mm	100% - All blocks	Caliper and Vision system	Intego ORION
Corner length	8.5 mm +/- 0.5 mm	100% - All blocks	Caliper and Vision system	Intego ORION
Angle between sides [ΦI]	90° +/- 0,3°	100% - All blocks	Caliper andVision	Intego ORION
Perpendicularity	90° +/- 0,3°	100% - All blocks	Caliper and Vision system	Intego ORION
Block length	475.0-502.0 (1 Block), 475.0-497.0 (2 Blocks in pairing, the shorter one larger than 150mm)	100% - All blocks	Caliper and Vision system	Intego ORION

4 Surface Properties

Property	Specification	Control frequenzy	Measuring Method	References
Ingot surface	As polished block	100% - All blocks	Visual	-
Surface roughness	Ra < 0.5 µm	10% of blocks	Mitutoyo	-

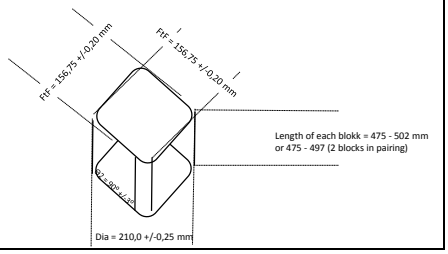
5 Apperance

Property	Specification	Control frequenzy	Measuring Method	References
Edge Defect	Length ≤ 0.3 mm, Width ≤ 0.3 mm	100% - All blocks	Visual	-
Surface Chipping	Length ≤ 0.3 mm, Width ≤ 0.3 mm. Seed and tail of block: 0.1 - 2.0 mm.	100% - All blocks	Visual	-
Crack and Pin Holes	No cracks w/ size > 1 mm. No Pin Holes	100% - All blocks	Visual	-

6 Packaging

Property	Specification
Traceability	All lot is idenified with a lot number.
Documantation	C of A pr block/lot. with diameter, flat length, corner lengt. res, Oi, Cs and lifetime.
Packaging method	Wood material outside and inside with stable support
Labelling on wooden box	Pallet number, specification and shipment number
Labelling /marking on block	Lot number and specification

7 Illustration



8 Explanations

1 Oxygen is measured on 1,5 mm test wafer using FTIR (after Thermal donor removal) - Measurement is done in center - Average of 5 measurements.
Note: Oxygen conc. is guaranteed to the customer specification at crystal growing inspection using test samples specifically prepared for oxygen analysis. Oxygen is not characterized on prime solar wafers.

2 Carbon is measured on 1,5 mm test wafer using FTIR (after Thermal donor removal) - Measurement is done in center - Average of 5 measurements.
Note: Carbon conc. is guaranteed to the customer specification at crystal growing inspection using test samples specifically prepared for carbon analysis. Carbon is not characterized on prime solar wafers.

3 Specific resistivity is measured on 1,5 mm test wafer by using 4-point probe after thermal donor removal (single wafer annealing. 750°C, 120 sec cyclus, Ar-atmosphere)
Note: Resistivity is guaranteed to the customer specification at crystal growing inspection using test samples specifically prepared for resistivity analysis. Resistivity is not characterized on prime solar wafers.

4 Bulk lifetime is measured on as cropped (i.e as squared) surface with Sinton BCT-0087 or BCT-210 equipment. QSS method is used for all values.
Specific Minority Carrier Density [cm^{-3}] is measured @ 2 x 10^{15} (characteristic for p-type).

5 Slip - lines is manually checked on as grown ingot before slabbing and tailslugs are checked with PL-camera

6 All chip length will be withdrawn from the total length and not included in the accepted length.