

## PRODUCT NOTE

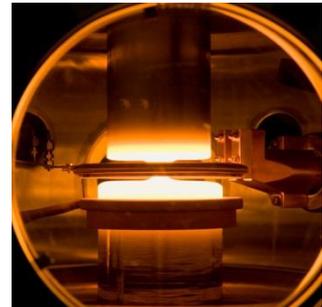
# PV-FZ™ Float Zone silicon shaped for the PV industry

This product specification covers float zone solutions for high efficiency, cost effective silicon solar cells with efficiencies above 20%. The most viable solution to the problem of getting a stable, high efficiency and low cost cell is to use monocrystalline silicon material with a high minority carrier lifetime in the bulk (hereafter referred to as the bulk lifetime) and low amounts of performance degrading impurities.

Cost effective process technology (CEPT) is a keyword in present solar cell module manufacturing. CEPT requirements are best met using screen printing technologies and Al back surface field (BSF) processing technologies in uncontrolled processing environments. None of these technologies support high bulk lifetimes, but they are used for almost every commercially available silicon solar cell module. Hence, the monocrystalline silicon material is normally unspecified or has low values of specification with respect to the bulk lifetime. There is no extra efficiency gain from choosing a high bulk lifetime silicon material, because the processing will have a negative impact on the lifetime thereby making the cell efficiency the same as the cell efficiency for the lower grade silicon material.

Process technologies to maintain a high bulk lifetime throughout the processing of the solar cells are considered costly and processing is normally performed in clean room environments. Indeed, a large number of solar cell developers have cost effective process recipes that do not severely impact the bulk lifetime, but they are using expensive electronic grade silicon to demonstrate the efficiency gain coming from their improved process.

PV-FZ™ silicon material will form the basis for the next generation of silicon solar cell modules supporting the ongoing development of stable, high efficiency and cost effective silicon solar cells. PV-FZ™ has been developed to meet both the material requirements and the cost levels required in terms of high minority carrier lifetime, low levels of performance degrading impurities and tight resistivity tolerances.



Float Zone silicon has generated the highest efficiencies ever measured for silicon solar cells. PV-FZ™ silicon has these superior material properties and will be used to set new standards in terms of efficiency and stability of silicon solar cells modules.

Topsil is a world leading supplier of float zone silicon for a number of applications. Continuous focus on R&D has resulted in products with the best performances ever measured on silicon wafers. This combined with more than half a century of experience in the production of float zone material and state-of-the-art wafering processes makes PV-FZ™ silicon the best choice for a stable, high efficiency and cost effective solar cell device.

Topsil offers Float Zone ingot and wafer substrates with the listed parameters. Other parameters than those in the table are possible on request.

#### CONTACT

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Growth method	PV-FZ™ Float Zone Silicon
Minority carrier lifetime	100-6000 μs depending on bulk resistivity
Bulk resistivity range	0.5-30 Ωcm
Resistivity tolerance	±20%
Ingot diameter	5"-150 mm
Crystal orientation	<100>
Type and Dopant	N (phosphorous), P (boron)
Oxygen concentration	< 2 x 10 <sup>16</sup> cm <sup>-3</sup>
Wafer geometry	Semi-square, round
Wafer thickness	225-300 μm
Wafer surface finish	Wire cut

## Topsil Semiconductor Materials A/S

Topsil is a world leading supplier of ultrapure silicon to the global semiconductor industry. Engaging in long term relations with customers, Topsil focuses on premium quality, an efficient production process and a safe delivery of products.

Topsil targets mainly the power market on which it provides ultrapure silicon for the most demanding purposes, based on extensive knowledge and significant investments in new technology, facilities and equipment, and a number of specialty areas.

Headquartered in Copenhagen Cleantech Park, Topsil spans production sites in Denmark and Poland and sales locations in Europe, Asia and the US. Topsil is publicly listed at the Nasdaq OMX Copenhagen stock exchange and was founded in 1959.

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