



NTD SILICON FOR DEMANDING POWER APPLICATIONS

- material solutions with a highly proven standard

Neutron Transmutation Doped (NTD) silicon has the lowest resistivity variation of any crystalline silicon product on the market. This is of paramount importance for high power semiconductor devices working under extreme loads. The record low resistivity variations guarantee safe and predictable operating limits for these critical components.

Thyristors, Diodes and Solid State Transistors all rely on uniformity of the basis material over large areas. Normal silicon monocrystalline growth can not guarantee this uniformity. However, by use of reactors with homogeneous and wide neutron beams Si_{30} isotopes can be transformed into n-type dopants in the form of P_{31} . The starting material for NTD products is intentionally undoped Float Zone silicon that has to meet certain minimum resistivity requirements. Topsil is supporting customers with NTD products in the widest range of resistivities ranging from 5 Ω cm to 4000 Ω cm. Key parameters for Topsil NTD products include

- The tightest resistivity tolerances of any silicon crystalline product
- Low levels of performance degrading impurities
- High minority carrier lifetime

Topsil is among the world leading suppliers of Float Zone silicon for a number of applications. Topsil was the first company in the world to market NTD float zone products. Focus on R&D at Topsil has resulted in continuous NTD product development. The latest product addition to the NTD family, NTD-4000, is a true cutting edge product targeting applications both in high power and detector technologies. The ingot growth and ex-situ ingot doping combined with state-of-the-art wafering processes makes Topsil NTD float zone silicon the best choice for a high power semiconductor product.



Topsil Semiconductor Materials A/S
 Linderupvej 4
 3600 Frederikssund, Denmark
 Telephone: +45 47 36 56 00
 Telefax: +45 47 36 56 01
 E-mail: topsil@topsil.com
 CVR-No. 24932818

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

Growth method	Neutron Transmutation Doped Float Zone Silicon
Bulk resistivity range	5-4000 Ωcm
Resistivity tolerance	$\pm 5\%$ - $\pm 10\%^*$
Radial resistivity variation (ASTM F81 planC)	< 3% - < 8%*
Striations	Not detectable
Minority carrier lifetime	> 300 μs depending on bulk resistivity
Ingot diameter	50-154 mm
Crystal orientation	<100>, <111>**
Type and Dopant	N (phosphorous)
Oxygen and Carbon concentration	< 10^{16} cm^{-3}
Wafer thickness	> 200 μm depending on wafer diameter
Wafer surface finish	As-cut, Lapped, Etched, Grinded, Polished

*Depending on bulk resistivity and ingot diameter.

**<111> is not available in 6" diameter.

For more than 45 years, Topsil has serviced the semiconductor industry with FZ and CZ silicon crystals and wafers. In close collaboration with our customers, research external institutions and partners, our dedicated R&D team has continued to introduce new world-class specified products to the market, in order to achieve our goal of being your full range silicon partner.

With a technological base as one of the few industrial manufacturers of Float-Zone crystals, Topsil has a strong focus on optimised production technology and flexibility, and our ISO 9001 certified quality engagement of the whole organisation, secures a high level of support and on-time delivery of top-quality products.