Krystal Technology

TSC Material Grades

Characteristics

- High purity quartz
- Solid and hollow material
- Low bubble content

Applications

- Semiconductor, solar, LED and flat panel display applications

TSC Grades

TSC ingots are manufactured either with highest quality natural quartz (TSC-3®, TSC-4) or from a synthetic raw material (TSC-S) resulting in the highest levels of purity and lowest inclusion and bubble levels.

TSC-3® and TSC-4 are fused using Krystral Technology's continuous flame fusion process. This process utilises advanced manufacturing concepts to reduce material waste when fabricating quartz parts. Hollow ingots can be custom sized to meet high volume ring applications, while round and rectangular blocks can be produced to efficiently yield windows and plates.

TSC-3® is the standard semiconductor grade material, ideal for use in single wafer processing applications such as plasma etch and deposition systems.

TSC-4 further reduces the risk of contamination by providing a lower Al and alkali metal content. TSC-4 has been designed for the most demanding semiconductor applications.

TSC-S is part of Krystal Technology's synthetic material family and is fully manufactured from synthetic raw material, guaranteeing highest levels of purity and consistency, along with lowest in class contamination levels and bubble count along with zero inclusions.

Available Dimensions

TSC-3® and TSC-4 are readily available in large sizes of up to 570 mm x 2200 mm. Extra large ingots, in sizes from 600 mm to 1300 mm square, are available on request, please check for availability.

Rectangular Ingots (Length up to 2200 mm)

Thickness (mm)				
	200	■		
	160	■	■	
	120	■	■	■
Width (mm)		450	540	1300

Round Ingots

Length (mm)						
	2100	■				
	1600	■	■			
	210	■	■	■		
	160	■	■	■	■	
	120	■	■	■	■	■
Diameter (mm)		310	350	420	540	670

Hollow Ingots

OD (mm)	up to 670
OD tolerance (mm)	+4 / -0
Wall thickness (mm)	≥ 20

Chemical Purity

Typical trace elements and OH content in quartz glass (ppm by weight oxide)

Grade	Li	Na	K	Mg	Ca	Fe	Cu	Cr	Mn	Ti	Zr	Al	OH
TSC-3®	0.2	0.3	0.2	< 0.01	0.4	0.05	< 0.01	< 0.01	< 0.01	1.1	0.8	15	170
TSC-4	0.04	0.2	0.08	< 0.01	0.7	0.1	< 0.01	< 0.01	< 0.01	1.3	0.7	8	170
TSC-S	< 0.01	< 0.01	< 0.01	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	150-200

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Bubbles and Inclusions

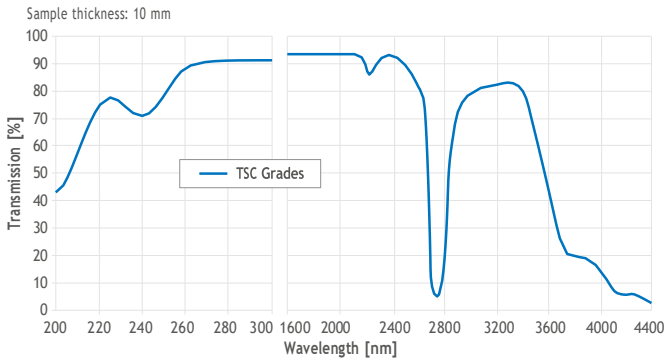
Krystal Technology's flame fusion process has been developed to ensure TSC materials have the lowest amount of bubbles and inclusion available in fused quartz materials.

Typical combined bubble and inclusion counts per 100 cm³

Diameter [mm]	TSC-3®	TSC-4	TSC-S
< 0.1	n. sp.	n. sp.	n. sp.
0.1 - 0.2	< 5	< 5	0
0.2 - 0.5	< 0.1	< 0.1	0
0.5 - 1	0	0	0
> 1	0	0	0

Typical Transmission Spectrum

(including Fresnel reflection losses)



Technical Properties TSC Grades

Mechanical Data

Density [g/cm³]	2.2
Mohs Hardness	5.5 ... 6.5
Micro Hardness [N/mm²]	8600 ... 9800
Knoop Hardness [N/mm²]	5800 ... 6100
Modulus of elasticity at 20 °C [N/mm²]	7.3×10^4
Modulus of torsion [N/mm²]	3.0×10^4
Poisson's ratio	0.16
Compressive strength [N/mm²]	~ 1110
Tensile strength [N/mm²]	~ 50
Bending strength [N/mm²]	~ 65
Torsional strength [N/mm²]	~ 30
Sound velocity [m/s]	5700

Thermal Data

	flame fused	synthetic
Softening temperature [°C]	1660	1600
Annealing temperature [°C]	1160	1100
Strain temperature [°C]	1070	1000
Max. working temp. [°C] continuous	1110	950
Max. working temp. [°C] short term	1250	1200

Mean specific heat [J/kg*K]

0 ... 100 °C	772
0 ... 500 °C	964
0 ... 900 °C	1052

Heat conductivity [W/m*K]

20 °C	1.38
100 °C	1.47
200 °C	1.55
300 °C	1.67
400 °C	1.84
950 °C	2.68

Mean expansion coefficient [K⁻¹]

0 ... 100 °C	5.1×10^{-7}
0 ... 200 °C	5.8×10^{-7}
0 ... 300 °C	5.9×10^{-7}
0 ... 600 °C	5.4×10^{-7}
0 ... 900 °C	4.8×10^{-7}
-50 ... 0 °C	2.7×10^{-7}

Electrical Data TSC Grades

Electrical resistivity [Ω*m]

20 °C	10^{16}
400 °C	10^{10}
800 °C	6.3×10^6
1200 °C	1.3×10^3

Dielectric strength [kV/mm]

(sample thickness ≥ 5 mm)

20 °C	25 ... 40
500 °C	4 ... 5

Dielectric loss angle (tg δ)

1 kHz	5.0×10^{-4}
1 MHz	1.0×10^{-4}
3×10^{10} Hz	4.0×10^{-4}

Dielectric constant (ε)

20 °C 0 ... 10^6 Hz	3.70
23 °C 9 ... 10^8 Hz	3.77
23 °C 3 ... 10^{10} Hz	3.81

UK

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