

TSC Material Grades

Applications

Semiconductor, solar, LED and flat panel display applications.

Characteristics

High purity quartz solid and hollow material with low bubble content.

TSC Grades

TSC ingots are made with the highest quality natural quartz powders that have been selected by Heraeus for their purity.

These selected powders are then fused using Heraeus' continuous flame fusion process resulting in a consistent, high purity material that has very few bubbles and inclusions.

TSC-3® and TSC-4 grades are available in a wide range of near net shape geometries that support advanced manufacturing concepts and reduce material waste. 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-3N is available in selected hollow geometries and is designed to meet the challenging needs of applications and markets that require careful balancing of performance and cost. Heraeus has designed TSC-3N to retain the inherent key benefits of the manufacturing process and allow them to be incorporated into cost sensitive applications across all product life cycles.

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.

TSC-3N is available in selected hollow geometries up to 450 mm OD.

Rectangular Ingots (Length up to 2200 mm)

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

Hollow Ingots

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

Round Ingots

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

Chemical Purity

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

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

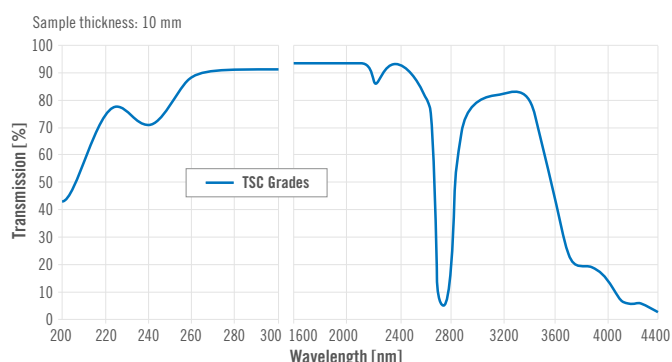
Bubbles and Inclusions

Heraeus' 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-4	TSC-3®	TSC-3N
< 0.1	n.sp.	n.sp.	n.sp.
0.1 - 0.2	< 5	< 5	< 5
0.2 - 0.5	< 0.1	< 0.1	< 0.1
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/cm ³)	2.2
Mohs Hardness	5.5 ... 6.5
Micro Hardness (N/mm ²)	8600 ... 9800
Knoop Hardness (N/mm ²)	5800 ... 6100
Modulus of elasticity at 20 °C (N/mm ²)	7.3 × 10 ⁴
Modulus of torsion (N/mm ²)	3.0 × 10 ⁴
Poisson's ratio	0.16
Compressive strength (N/mm ²)	~ 1110
Tensile strength (N/mm ²)	~ 50
Bending strength (N/mm ²)	~ 65
Torsional strength (N/mm ²)	~ 30
Sound velocity (m/s)	5700

Thermal Data

Softening temperature (°C)	1730
Annealing temperature (°C)	1200
Strain temperature (°C)	1080
Max. working temperature (°C) continuous	1050
Max. working temperature (°C) short term	1350

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

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