Silica glass

Description

Image

Caption

1. Halogen bulb. © Stefan Wernli, stef at en.wikipedia - (CC BY-SA 2.5) 2. Silica glass is used for very high-power lamp envelopes. © Granta Design

The material

Fused silica, a glass of great transparency, is nearly pure SiO2, it has an exceptionally high melting point and is difficult to work, but, more than any other glass, it resists temperature and thermal shock.

Composition (summary)

SiO2

General properties

Density		135	-	139	lb/ft^3
Price	*	2.82	-	4.7	USD/lb
Date first used		1905			

Mechanical properties

Young's modulus		9.86	-	10.7	10^6 psi
Shear modulus	*	4.05	-	4.68	10^6 psi
Bulk modulus		4.93	-	5.22	10^6 psi
Poisson's ratio		0.15	-	0.19	
Yield strength (elastic limit)	*	6.53	-	22.5	ksi
Tensile strength	*	6.53	-	22.5	ksi
Compressive strength		160	-	232	ksi
Elongation		0			% strain
Hardness - Vickers		450	-	950	HV
Fatigue strength at 10^7 cycles	*	6.24	-	20.7	ksi
Fracture toughness		0.546	-	0.728	ksi.in^0.5
Mechanical loss coefficient (tan delta)		8e-6	-	2e-5	

Thermal properties

Glass temperature	*	1.75e3	-	2.83e3	°F
Maximum service temperature		1.65e3	-	2.55e3	°F
Minimum service temperature		-460			°F
Thermal conductor or insulator?		Poor insulator			
Thermal conductivity		0.809	-	0.867	BTU.ft/h.ft^2.F
Specific heat capacity		0.162	-	0.174	BTU/lb.°F
Thermal expansion coefficient					

	0.306	-	0.417	µstrain/°F

Electrical properties

Electrical conductor or insulator?	Good insulator			
Electrical resistivity	1e23	-	1e27	µohm.cm
Dielectric constant (relative permittivity)	3.7	-	3.9	
Dissipation factor (dielectric loss tangent)	2e-5	-	6e-5	
Dielectric strength (dielectric breakdown)	838	-	965	V/mil

Optical properties

Transparency	Optical Quality			
Refractive index	1.46			

Processability

Castability	1	-	2	
Moldability	2	-	3	
Weldability	3	-	4	

Eco properties

Embodied energy, primary production	*	4.05e3	-	4.49e3	kcal/lb
CO2 footprint, primary production	*	2.2	-	2.43	lb/lb
Recycle	✓				

Supporting information

Design guidelines

Silica glass is exceptionally hard to shape, requiring either very high working temperatures or special process by which it is formed after working. This makes it much more expensive than soda lime or borosilicate glass.

Typical uses

Space vehicle windows, wind tunnel windows, lenses and mirrors, ultrasonic delay lines, crucibles for semiconductor crystal growing,spectrophotometric optical systems; high temperature glass applications; envelopes for high wattage lamps, thermal barrier coatings.

Tradenames

Lucalox

Links

Reference

ProcessUniverse

Producers