

Silicon Dioxide, SiO₂ for Optical Coating

Applications

Silicon Dioxide, SiO₂, is the low-index, low absorption material used in combination with high-index oxide layer coatings that operate in the UV (~200 nm) to IR (~3 μm) regions. Typical applications include anti-reflection coatings for near-UV laser optics, all-dielectric mirrors, beam-dividers, band-pass filters, and polarizers. Silica can be used in combination with specific high-index layers, for example Hafnia, Zirconia, and Tantalum, to form multilayer structures with high damage thresholds for specialized UV laser applications.

Silica films sometimes are useful in promoting adherence between two dissimilar materials, especially oxide-compositions. In contrast to the parent quartz form, Silica films are amorphous and never obtain the equivalent density, hardness or water impermeability of the crystal form.

Film Properties

Completely oxidized silica films are absorption-free over the range below ~250 nm to at least 5 μm. Film layers are amorphous and smooth. High mechanical compressive stress limits the thickness the single layer thickness. When starting from Silica pieces, little dissociation and oxygen loss occurs during evaporation, and it is not always necessary to provide a background pressure of oxygen to obtain low-absorbing films.

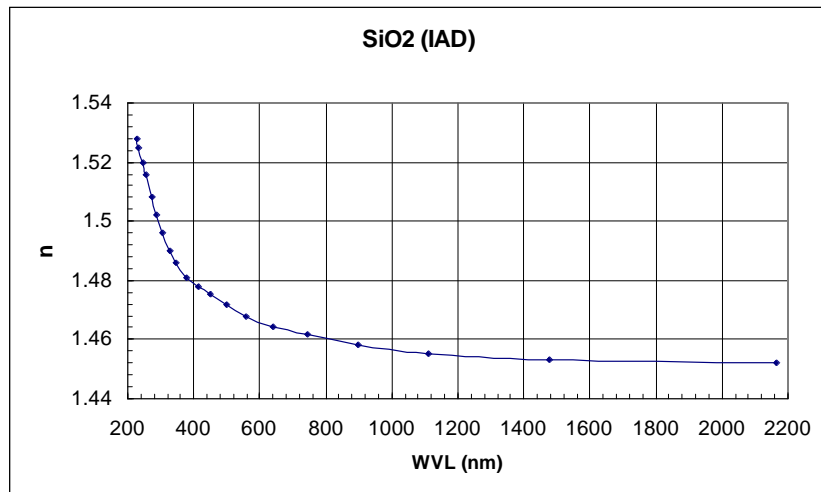
Adhesion is good to glass, most other oxides, and some polymers. The films generally grow with an amorphous structure and relatively high packing density so they exhibit minimum index changes when vented to moist air. The appearance of water absorption bands near 2.9 and 6.2 μm indicates less than perfect packing density. The refractive index is maximized and water band absorption is minimized with the use of high energy deposition techniques such as IAD or sputter deposition and high substrate temperature.

Low absorption SiO₂ films can be produced by oxidizing Silicon Monoxide in a reactive

oxygen background. Evaporation would proceed from a baffled box and therefore the possibility of generating micro-particles is eliminated. Alternatively, evaporation can proceed from flat surfaces of large pieces of Silicon Monoxide that are swept by a low-power e-beam. Films so deposited exhibit low optical absorption, but the possibility exists for particulate emission.

Refractive Index

The refractive indices are dependent on the degree of oxidation, the substrate temperature, and the deposition energy. The curve below shows typical values. They can be slightly higher than values for fused Silica.



Index dispersion curve for silicon dioxide deposited using IAD on a 200 substrate.

Material Behavior

Recommended preconditioning consists of slow sweeping of the electron beam to fuse the top surfaces of suitably sized pieces. Prevent hole drilling by using a rapid large area sweep. Replace the charge when it becomes dark colored. Alternatively, start with SiO from a baffled box source and provide a highly reactive oxygen atmosphere ~1-2 E-04 Torr.

Physical Properties of Solid Material

Molecular Weight	60
Melting Point	1700° C
Color	Clear to white (see item description)
Crystal Density	2.17g/cc

Ordering Information

For specific product information or to place an order, contact CERAC customer service at ceraccustserv@beminc.com or by phone at +1-414-289-9800. Visit www.cerac.com for a complete list of global sales and service locations.

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Evaporation Parameters

Evaporation temperature	~1200° C
Source Container	No liner for E-beam
Rate	2 Å/sec.
Partial pressure of oxygen	1 x 10 ⁻⁵ Torr
Substrate temperature	200° C to 300° C
Quartz crystal monitor Z-ratio	1

Forms and Sizes

Available

CERAC offers materials for evaporation as well as sputtering targets. To view pricing on our standard catalog items, please visit

our on-line catalog at www.cerac.com and look-up by item number, chemical name or CAS number. If you require a custom manufactured item, please contact our sales department at +1-414-289-9800 or ceracsales@beminc.com with your specific requirements. You can also fill out our quotation request form.

Item Number	Purity	Description
S-1196	99.7%	1-5mm fused pieces
S-1124	99.99% (<5ppm OH)	3-12mm fused pieces
S-1160	99.99%	1-3mm fused pieces
S-1161	99.99%	3-12mm fused pieces
S-2081	99.99%	1-3mm fused pieces

Full Line of Thin Film Materials

CERAC manufactures a complete line of vacuum deposition materials for optical coating applications including powders, pellets, pieces, tablets, rods, cones, crucibles, evaporation discs, pre-melted evaporants and sputtering targets.

Contact a CERAC Sales representative at +1-414-289-9800 or ceracsales@beminc.com for additional information.



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