

Cerium Dioxide, CeO₂

Applications

Cerium Dioxide is a coating material with high refractive index in the visible, and transparency to IR wavelengths >10 μm. Layers are deposited by electron-beam evaporation, preferably with IAD. Thick layers exhibit very low stress and good adhesion to glass, fused silica, silicon, and Ge substrates. However, the growth microstructure is strongly columnar, and therefore the films are soft and porous. This growth property permits the growth of structured (sculptured) layers including birefringent films and films that might be useable in photocatalytic applications.

Film Properties

Fully oxidized CeO₂ films are absorption-free over the wavelength range to ~500 nm to at least 12 μm in the IR. Adhesion is excellent to glass and to most other oxide compounds. Film layers exhibit large inhomogeneity in index: index is highest near the substrate and can decrease by >10% toward the top of the layer (wavelength dependent). Films in thick layers have rough surfaces because they grow with a coarse columnar structure. Such films are easily damaged by abrasion, for example the moderate abrasion test of the MIL-STD C-48497. The upper thickness of the film can be burnished with cloth. Durability can be increased, however, by over coating with Y₂O₃ or SiO₂, depending on application. Roughness of thick film layers can be reduced by interposing thin layers of Y₂O₃, or for the case of a multi-layer structure,

alternating with layers of SiO₂. Cerium Dioxide layers are insoluble in boiling water and in most acids.

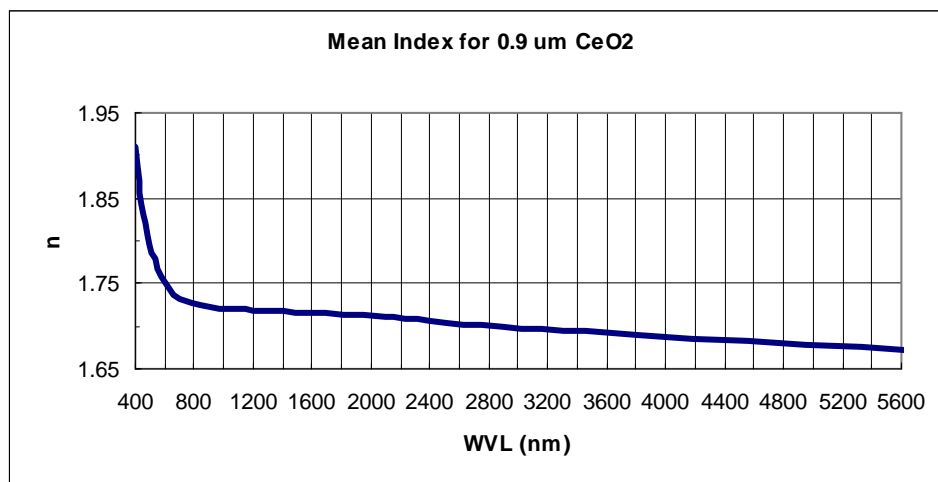
Refractive Index

The columnar growth form tapers to smaller diameter with height away from the substrate, causing the refractive index to decrease with thickness as void volume increases and packing density decreases. High ion-energy (keV) at high current densities reduce this low-density effect and produce higher indices. CERAC can prepare special compositions based on admixtures of glass-forming oxides to promote increased packing density.

The refractive index curve presented below was measured for a 900 nm thick film deposited using IAD (~200 eV) and 200 substrate temperature. Data from glass and Germanium substrates are combined in the curve.

Material Behavior

The material sublimates and is best evaporated by E-beam. Evaporation is smooth and rate is stable. Beam sweep should be used, and power and rate should be limited to reduce particulate ejection. Evaporation causes only a small oxygen loss that will be restored with the addition of a partial pressure of oxygen during reactive deposition.



Refractive indices for a thick layer of Cerium Dioxide deposited by e-beam on substrates at 200 C.

Evaporation Parameters

Evaporation temperature	~1600° C
Source Container	Tantalum or graphite liner for E-beam
Rate	2-5 Å/sec.
Partial pressure of oxygen	~5 x 10 ⁻⁵ Torr
Substrate temperature	200° C to 400° C.

Physical Properties of Solid Material

Molecular Weight	172 g/mol
Melting Point	>2600° C
Color	white
Crystal Density	7.1g/cc

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
C-1065	99.9%	3-6 mm pcs
C-1200	99.9%	10-12mm dia. x 4-5mm thick tablets
EC-129	99.9%	evaporation cone
SS-343	99.9%	sputtering target

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.

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 ceracinfo@beminc.com for additional information.



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