Zinc Selenide, ZnSe for IR Optical Coatings

Applications

Optical Zinc Selenide, ZnSe, films are transparent over the region between ~500 nm and 14 µm. It is the high-index component (n~2.4) used in combination with low-index fluoride compounds to construct beamsplitter, bandpass filter, and other coatings in the IR region at wavelengths longer than 2 µm. Low-index companion layers materials include YF_3, YbF_3, IRX and ThF_4. It is typically the low-index component used in combination with Ge (n=4) in multi-layer designs. ZnSe is easy to deposit and exhibits low optical absorption and low mechanical stress, even in layers several µm thick. Combination with oxide layers is not recommended because of the risk of adhesion problems between chemically dissimilar materials.

Film Properties

The films grow with a characteristic columnar microstructure whose column size and void volume (comprising packing density) are dependent on the substrate temperature. Zinc Selenide layers are relatively soft and insoluble in water. Unlike oxide films of similar low packing density, little shift in optical properties such as index is exhibited between humid and arid atmospheres.

The chart shows the refractive index dispersed between wavelengths 1000 nm and 16,000 nm. The high dispersion rate below 1000 nm limits the usefulness of ZnSe in NIR designs, while its low dispersion rate at IR wavelengths is an advantage.

Refractive Index

Refractive indices are dependent on the degree of oxidation and the film density achieved. Deposition processes for oxide compounds typically include IAD to increase the refractive index and to discourage crystalline growth, thus producing higher packing density. With Lanthanum Titanate, the film growth is highly dense and only a small index gain is achieved with IAD. Similarly, stability to moisture is high without IAD.

Typical index values are plotted below for films deposited with- and without-IAD. The addition of IAD increases the index by ~0.06.

Evaporation Parameters

While Zinc Selenide can be evaporated by E-beam, resistance-heated evaporation is generally used in optical work. The sublimation temperature is 800 - 900°C so it is easier to obtain stoichiometric composition using the more gentle resistance-heated thermal technique. Recommended substrate temperature is near 160° - 175° C. At higher temperatures, arriving adatoms exhibit lower condensation rates ("sticking coef.") and result in thickness errors between the hot substrate and, for example, the crystal thickness/rate monitor. Thorough cleaning of the substrate surface is also essential for good coating adhesion. Often a very thin adhesion-promoting layer of HfO_2, Y_2O_3, or a fluoride compound is required on Ge and other substrate materials. Typical resistance-heated evaporation sources are baffled box configurations made of of Ta or Mo. A gentle ramping of the source heating is suggested to minimize dispersion of the components which would inhibit complete compositional recombination. Typical evaporation rates are 10-15Å per second at a background pressure below 10-5 Torr.

Physical Properties of Solid Material

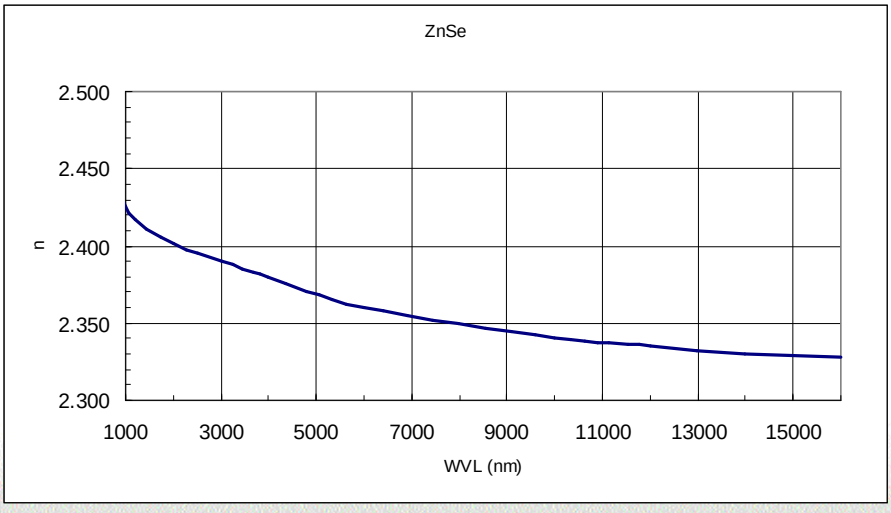
Evaporation by Sublimation
Visual Appearance: Yellowish translucent
Density at 25°C, 5.4 g/cc
Water Solubility: Insoluble. There is no water penetration into solid pieces.

Forms and Sizes Available

ZnSe is available as pieces, cubes, sputtering targets and customer specified shapes.

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.



CERAC, inc.
Subsidiary of Williams Advanced Materials
P.O. Box 1178
407 N. 13th Street
Milwaukee, WI 53201-1178 USA
Phone: +1-414-289-9800 Fax: +1-414-289-9805
ceracinfo@beminc.com www.cerac.com