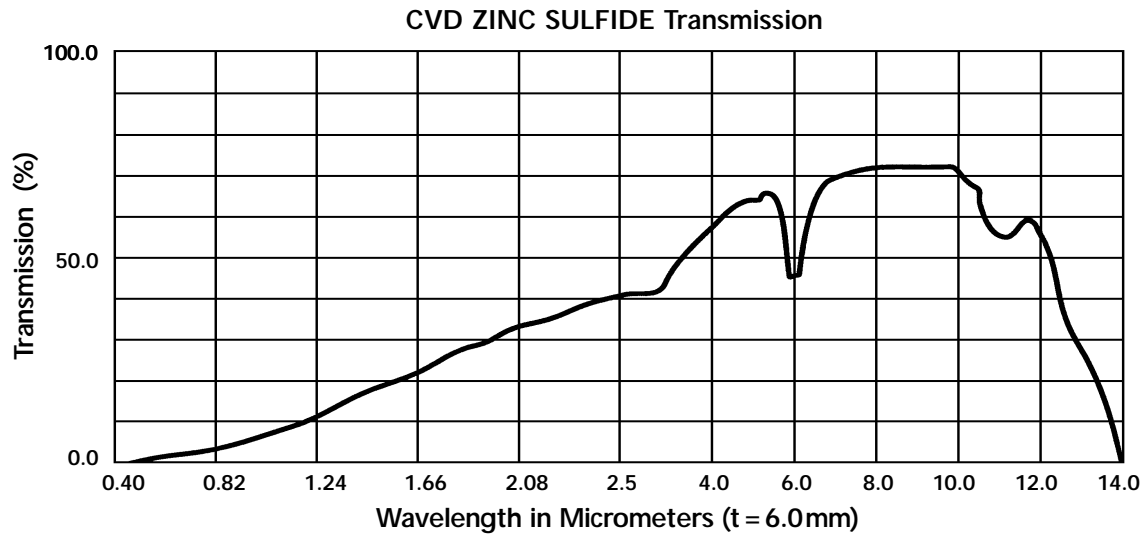


**CVD ZINC SULFIDE®**



**Application**

Chemically vapor deposited zinc sulfide (CVD ZnS) is the low cost alternative for infrared windows, domes and optical elements. With a fracture strength double that of zinc selenide and high hardness, zinc sulfide has been used successfully in many military applications requiring mechanical resistance to hostile environments. Missile domes and external windows for military aircraft have been produced by Advanced Materials' CVD ZINC SULFIDE as the mechanical features of this material allow for high resistance to rain and dust. Its low cost also makes it attractive for commercial applications.

Advanced Materials' CVD ZINC SULFIDE is chemically inert, non-hygroscopic, highly pure, theoretically dense and easily machined. Like zinc selenide, zinc sulfide displays a high level of index of refraction homogeneity and offers imaging uniformity across the 8-12 micron waveband. This material also transmits in the mid-wave IR region, but with higher absorption and scatter as the wavenumber increases.

Custom diameters, rectangles, CNC-profiled blanks, generated lens blanks, prisms and near-net shape domes can be made to your specifications. Sheet material is also available

Advanced Materials' CVD ZINC SULFIDE is also available as an evaporative source material. It is supplied in specified lump sizes (2-20mm) which to minimize surface contamination are hand selected to be free from saw cut, abraded or polished edges.

**Optical Properties**

10% transmission limits (t=6mm)	1.0 - 14 $\mu$ m
Index of refraction inhomogeneity ( $\Delta n/n$ ) (ppm @ 10.6 $\mu$ m)	<100
Thermo-optic coefficient, $dn/dT$ (298-358K) (avg. values, see back page for more details)	
( $K^{-1}$ @ 1.15 $\mu$ m)	$4.6 \times 10^{-5}$
( $K^{-1}$ @ 3.39 $\mu$ m)	$4.3 \times 10^{-5}$
( $K^{-1}$ @ 10.6 $\mu$ m)	$4.1 \times 10^{-5}$
Bulk absorption coefficient ( $cm^{-1}$ @ 10.6 $\mu$ m)	$2.0 \times 10^{-1}$

**Physical Properties**

Crystal structure	cubic
Grain size (diameter)	2 - 8 $\mu$ m
Density ( $g\ cm^{-3}$ @ 298 K)	4.09
Resistivity ( $\Omega cm$ )	$\approx 10^{12}$
Chemical purity (%)	99.996
For dielectric constant data, please request the Dielectric Properties bulletin.	

**Thermal Properties**

Coefficient of Thermal Expansion	
( $K^{-1}$ @ 273 K)	$6.6 \times 10^{-6}$
( $K^{-1}$ @ 373 K)	$7.3 \times 10^{-6}$
( $K^{-1}$ @ 473 K)	$7.7 \times 10^{-6}$

Thermal conductivity	
( $JK^{-1}m^{-1}s^{-1}$ @ 298 K)	16.7
Heat capacity ( $Jg^{-1}K^{-1}$ @ 298K)	0.469

*Maximum operating temperature will depend on the environment.*



## Indices of Refraction (n) of CVD ZINC SULFIDE<sup>1</sup>

as a function of wavelength at room temperature (20°C)

Wavelength ( $\mu\text{m}$ )	n	Wavelength ( $\mu\text{m}$ )	n
0.42	2.516	7.00	2.232
0.46	2.458	7.40	2.228
0.50	2.419	7.80	2.225
0.54	2.391	8.20	2.221
0.58	2.371	8.60	2.217
0.62	2.355	9.00	2.212
0.66	2.342	9.40	2.208
0.70	2.332	9.80	2.203
0.74	2.323	10.20	2.198
0.78	2.316	10.60	2.192
0.82	2.310	11.00	2.186
0.86	2.305	11.40	2.180
0.90	2.301	11.80	2.173
0.94	2.297	12.20	2.167
0.98	2.294	12.60	2.159
1.00	2.292	13.00	2.152
1.40	2.275	13.40	2.143
1.80	2.267	13.80	2.135
2.20	2.263	14.20	2.126
2.60	2.260	14.60	2.116
3.00	2.257	15.00	2.106
3.40	2.255	15.40	2.095
3.80	2.253	15.80	2.084
4.20	2.251	16.20	2.072
4.60	2.248	16.60	2.059
5.00	2.246	17.00	2.045
5.40	2.244	17.40	2.030
5.80	2.241	17.80	2.015
6.20	2.238	18.20	1.998
6.60	2.235		

## Thermo-optic Coefficient, CVD ZINC SULFIDE<sup>1</sup>

$dn/dT$  ( $10^{-5}K^{-1}$ )

Temp °C	Wavelength ( $\mu\text{m}$ )		
	1.15	3.39	10.6
-180	3.5	2.8	2.7
-160	3.7	3.1	3.0
-140	3.8	3.3	3.3
-120	4.0	3.5	3.5
-100	4.1	3.7	3.7
-80	4.2	3.9	3.8
-60	4.3	4.0	3.9
-40	4.4	4.1	4.0
-20	4.5	4.1	4.0
0	4.5	4.2	4.1
20	4.6	4.2	4.1
40	4.6	4.3	4.1
60	4.7	4.3	4.1
80	4.7	4.3	4.1
100	4.7	4.3	4.2
120	4.8	4.4	4.2
140	4.8	4.4	4.3
160	4.9	4.4	4.4
180	4.9	4.5	4.5
200	5.0	4.6	4.7
$\sigma^a$	0.2	0.2	0.2

<sup>a</sup>Standard deviation from a third degree polynomial fit.

<sup>1</sup>A. Feldman et al, Final Technical Report Feb. 1, 1978 - Sept 30, 1978, National Bureau of Standards Technical Note 933, 53-54

## Mechanical Properties

Hardness:	Knoop, 50 gm load ( $\text{kg mm}^{-2}$ )	200-235
	Vickers, 1kg load ( $\text{kg mm}^{-2}$ )	230
Flexural Strength (modulus of rupture)		
	4 pt. loading (psi)	$15 \times 10^3$
	4 pt. loading (MPa)	103
	Disc Bursting (MPa)	84
Fracture toughness (critical stress intensity factor, $K_{Ic}$ values)		
	( $\text{MPa}\sqrt{\text{m}}$ , Vickers, 1 Kg)	0.8
Young's modulus (elastic modulus)		
	(psi)	$10.8 \times 10^6$
	(GPa)	74.5
Poisson's ratio		0.29
Rain erosion resistance	will depend on the environment.	

For more information, visit our website at [www.cvdmaterials.com](http://www.cvdmaterials.com)

### United States:

Rohm and Haas Company  
Advanced Materials  
185 New Boston Street  
Woburn, MA 01801  
Tel: 800/552-2283  
Tel: 781/933-9243  
Fax: 781/933-5142

### Pacific Rim:

Australia, Japan, Korea,  
Singapore, Taiwan  
Rohm and Haas Japan K.K.  
Metalorganics and Advanced Materials  
The Vanguard Motoazabu  
4-26 Motoazabu 3-chome, Minato-ku,  
Tokyo, Japan 106-0046  
Tel: 81-3-5488-3230  
Fax: 81-3-5488-3231

### United Kingdom and Continental Europe:

Rohm and Haas (UK) Ltd.  
Advanced Materials  
Unit 43, Britannia Way  
Britannia Enterprise Park  
Lichfield  
Staffordshire, WS14 9UY  
United Kingdom  
Tel: 44 1543 410 111  
Fax: 44 1543 410 666

® CVD ZINC SULFIDE is a registered trademark of Rohm and Haas Company

ZNS Rev.1 5/00

The information contained herein is, to the best of our knowledge and belief, accurate. However, since the conditions of handling and of use are beyond our control, we make no guarantee of results and assume no liability for damages incurred by following these suggestions. Nothing contained herein is to be construed as a recommendation for use in violation of any patents or of applicable laws or regulations.

© Copyright 2000, Rohm and Haas Company