



Engineering Better Material Solutions

ALON[®] and Spinel Optical Ceramics



For quotation contact:
Surmet Corporation
31 B Street, Burlington MA 01803

781-272-3969 phone
781-272-9185 fax
sales@surmet.com

ALON®

TECHNICAL DATA

ALON® Optical Ceramic

ALON® Optical Ceramic is an extremely durable crystalline material with excellent optical transparency in the near ultraviolet, visible and infrared up to approximately 5 μm wavelength.

ALON® Optical Ceramic is fabricated using a proprietary powder processing technique. The material combines mechanical and optical properties similar to sapphire with the advantages of an isotropic cubic crystal structure. It has an approximate composition of $Al_{23}O_{27}N_5$.

ALON® Optical Ceramic can be made to order as windows, domes, plates, rods and tubes in a wide range of sizes and thicknesses by a variety of conventional ceramic forming methods such as injection molding, isostatic pressing and slipcasting.



TYPICAL PROPERTIES OF ALON® OPTICAL CERAMIC

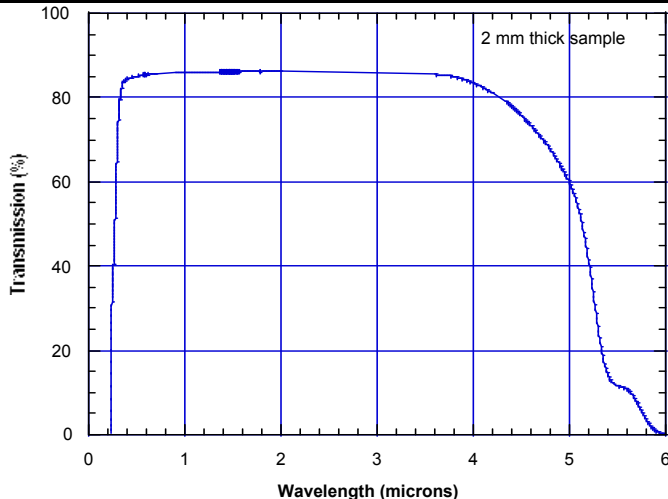
Composition.....	$Al_{23-1/3X}O_{27+X}N_{5-X}$ (0.429 < X < 2)
Grain Size (typical).....	150-250 microns
Structure.....	Cubic, Spinel
Lattice Constant.....	7.956Å – 7.936Å
Density.....	3.696 – 3.691 g/cc
Form.....	Polycrystalline
Melting Point.....	2150°C
Young's Modulus.....	46.9×10^6 psi
Shear Modulus.....	18.9×10^6 psi
Poisson's Ratio.....	0.24
Hardness.....	1850 Kg/mm ² (Knoop Indentation, 200g load)
Fracture Toughness.....	2.0 MPa-m ^{1/2}
Flexure Strength.....	55,000 psi
Specific Heat.....	0.22 cal/g-°C
Thermal Conductivity	(cal/cm-s-°C)
	75°C..... 0.023
	270°C..... 0.017
	540°C..... 0.015
	830°C..... 0.017
Transmission Limits	0.22 to 6 microns

Thermal Expansion Coeff.

30-200°C	5.65×10^{-6}
30-400°C	6.40×10^{-6}
30-600°C	6.93×10^{-6}
30-900°C	7.50×10^{-6}

Dielectric Properties

Freq. (GHz)	k	tan δ (x10 ⁻⁵)
35-45	9.190	31
55-60	90181	67
90-110	9.175	96



Index of Refraction

$\lambda(\mu m)$	n
0.48	1.803
0.50	1.801
0.64	1.790
0.68	1.788
0.70	1.787
1.00	1.779
2.00	1.761
3.00	1.737
4.00	1.702
5.00	1.653

Infrared

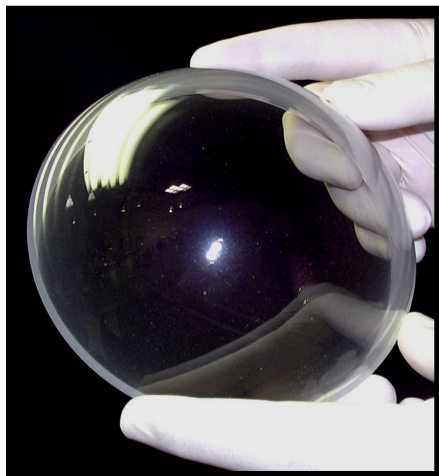
Absorption Coefficient

$\lambda(\mu m)$	$\alpha (cm^{-1})$
3.8	0.080
4.000	0.159
4.230	0.288
4.380	0.409
4.545	0.598
4.717	0.849
4.902	1.230
5.000	1.598
5.102	2.000
5.319	5.230
5.550	8.060
5.814	11.030

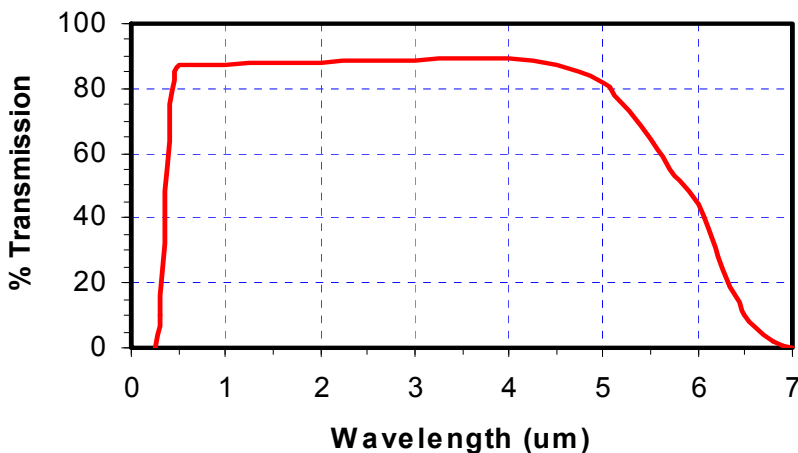
Spinel

TECHNICAL DATA

Spinel Optical Ceramic



Spinel Transmission



Composition.....	MgAl ₂ O ₄
Form.....	Polycrystalline
Lattice Constant.....	8.082 Å
Density* ¹	3.58 g/cc
Melting Point* ¹	2135°C
Grain Size (typical).....	Bimodal, 25 um average and 150 um average
Crystal Structure.....	Cubic, Spinel
Young's Modulus* ¹	276 GPa
Poisson's Ratio* ¹	0.26
Thermal Expansion* ¹	6.97 x 10 ⁻⁶ (30-200 C)
Hardness* ¹	1650 kg/mm ² (Knoop Indentation, 200g load)
Fracture Toughness* ¹	1.5 MPa-m ^{1/2}
Flexure Strength* ¹	170 MPa
Specific Heat* ¹	0.8191 J/g - °C
Thermal Conductivity* ¹	25 W/m-C @ 25°C
Transmission Limits* ¹	0.25 to 6.5 microns
Typical Transmission.....	76% @ 0.65 um
(@ 4 mm thickness)	83% @ 1.064 um
	82% @ 4.5 um
Ref. Index Homogeneity..	<5 x 10 ⁻⁶ over 3.0" diameter
(RMS)	<9 x 10 ⁻⁶ over 4.7" diameter



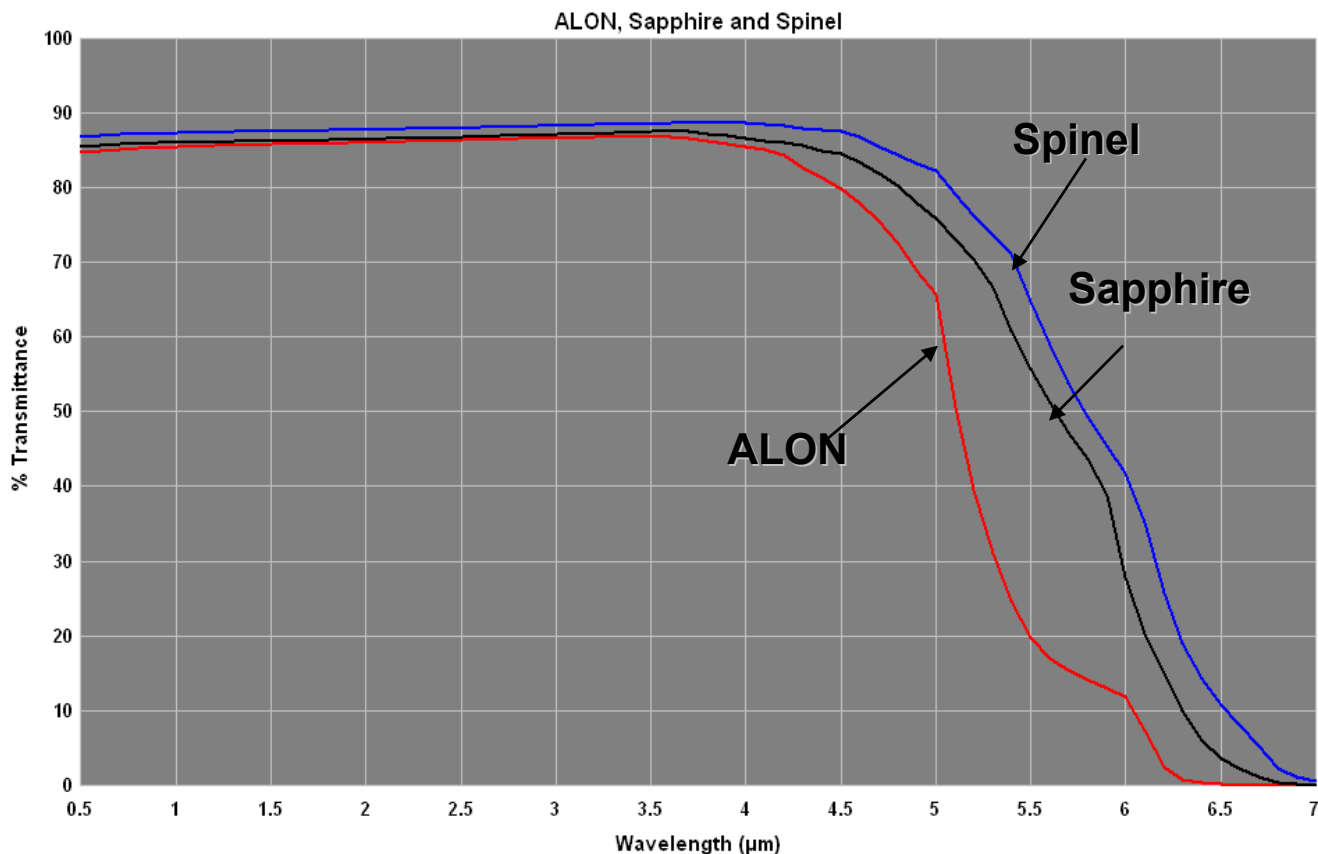
Index of Refraction			
λ (um)	η	λ (um)	η
0.404	1.7359	1.00	1.703
0.50	1.7230	2.40	1.6807
0.60	1.7155	3.00	1.6677
0.70	1.7108	4.00	1.6386
0.80	1.7075	5.00	1.598

*1- Reference 1: Handbook of Optics Volume II ,McGraw Hill, Inc. (1995)

For quotation contact:
Surmet Corporation
 31 B Street, Burlington MA 01803

781-272-3969 phone
 781-272-9185 fax
 sales@surmet.com

Comparison of Transmission (2 mm thick samples)



***Spinel transmits out further than Sapphire,
which transmits out further into the
MWIR than ALON® Optical Ceramic***

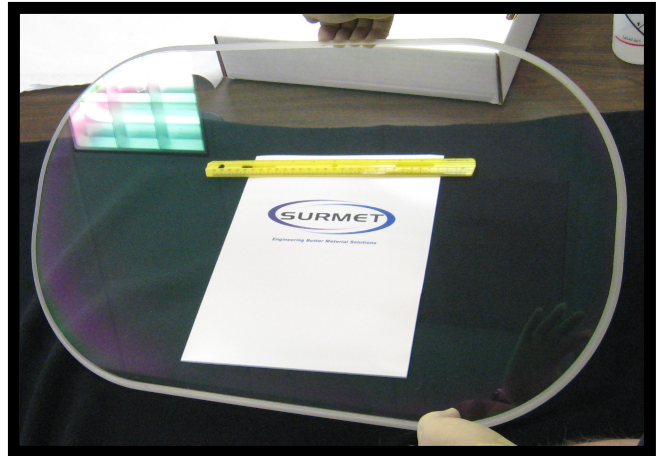


Engineering Better Material Solutions

ALON[®] and Spinel Optical Ceramics IR Windows and Domes



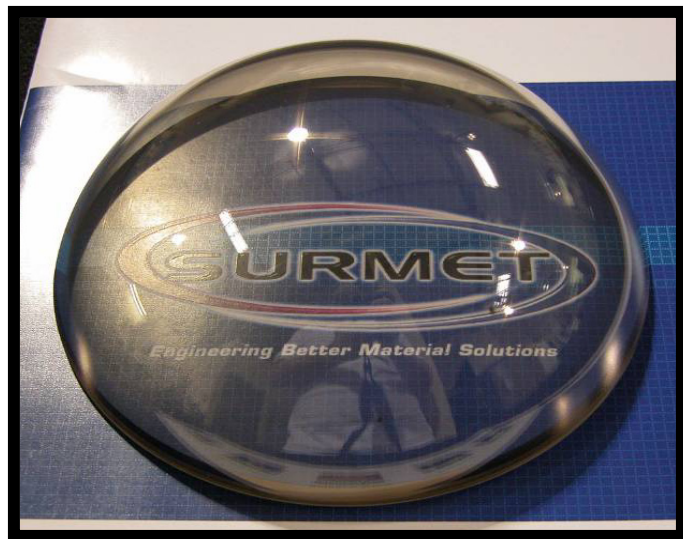
**ALON[®] Hyper-Hemisphere
for Counter-Manpads**



Reconnaissance Window



Spinel Lens



Spinel Tri-Mode Seeker Dome

ALON[®] and Spinel can be made in large sizes and more complicated geometries than Sapphire

For quotation contact:
Surmet Corporation
31 B Street, Burlington MA 01803

781-272-3969 phone
781-272-9185 fax
sales@surmet.com



Engineering Better Material Solutions

Foreign Object Damage Resistance

Granite rock fired at ALON® window

ALON ROCKS!

Rock Fired at ALON



Impact at 175 MPH

It is the ROCK that explodes!

For quotation contact:
Surmet Corporation
31 B Street, Burlington MA 01803

781-272-3969 phone
781-272-9185 fax
sales@surmet.com