

Terbium Gallium Garnet - TGG

Terbium Gallium Garnet (TGG) is a crystal material for optical isolator devices. Optical isolator devices make use of the non-reciprocal Faraday effect in TGG. The Faraday effect is the rotation of the plane of polarization of a light beam as it is transmitted through a material in the presence of an external magnetic field coaxial with the light. The polarization rotation is in the same sense regardless of the direction of propagation of the light. An optical isolator is a Faraday rotator combined with suitably aligned polarizers which allows light to pass in one direction only.

Advantages Of TGG Include:

Superior to terbium-doped glasses

- TGG has twice the Verdet constant of a Terbium-doped glass.
- The thermal conductivity of crystalline TGG is an order of magnitude greater than a typical glass.
- Optical losses are lower for TGG than Tb-doped glasses.
- The combination of the above factors make TGG better suited to high average power applications. The principal limiting factor is thermally induced beam distortion. Beam distortion is less for TGG than Tb-doped glasses under the same power loading level.

Comparison of TGG & Tb-Doped Glass Properties @ 1064 nm

	<u>TGG</u>	<u>Tb-Glass</u>	
Verdet Constant, V:			
@1064 nm	-40	-20	RadT ⁻¹ m ⁻¹
@ 632 nm	-134	-70	RadT ⁻¹ m ⁻¹
Absorption Coefficient, α	0.0015	0.003	cm ⁻¹
Thermal Conductivity	7.4	0.7	Wm ⁻¹ K ⁻¹
Refractive index, n	1.95	-	-
Nonlinear Index, n_2	8.0	2.45	10 ⁻¹³ esu
Figure of Merit⁽¹⁾, V/α	27	7	-
Figure of Merit⁽²⁾, V/n_2	5	8	-

Standard Rod Specifications

Material Parameters

Crystal:	Terbium Gallium Garnet (Tb ₃ Ga ₅ O ₁₂)
Orientation:	[111] within 5 degrees
Wavefront Distortion (measured at 632 nm): - Large rods with diameter > 3 mm or length > 25.4 mm: - Small rods with diameter < 3 mm or length < 25.4 mm:	< 1/8 wave / inch < 1/8 wave total
Extinction Ratio:	30 dB over 2/3 clear aperture

Dimensional Tolerances

Diameter:	+0.000" / -0.002"
Length:	+0.010 / -0.010"
Barrel Finish:	55 ± 5 μinch (RMS)
Chamfer:	0.005" ± 0.003" at 45° ± 5°

End Configuration

Flatness:	λ / 10 wave at 633 nm wavelength
Parallelism:	< 1 minutes of arc
Perpendicularity:	< 10 minutes of arc
Surface Quality:	10 - 5 scratch-dig per MIL-0-13830A

Anti-Reflection Coatings

Reflectivity:	< 0.25% at 1064 nm
Adhesion and Durability:	meets MIL-C-48497A standards
Pulsed Damage Threshold:	10 J / cm ²

Specifications and information are subject to change without prior notice.
© 2011 Northrop Grumman Corporation MS1022 02/02