

Chromium, Thulium, Holmium: Yttrium Aluminum Garnet - CTH:YAG

CTH:YAG is a new crystal material which lases at 2080 nm. It has applications in medical, military and meteorological fields.

The key to efficient operation lies in the energy transfer processes between co-dopants of Cr, Tm and Ho. Cr³⁺ acts to effectively absorb flashlamp energy, which is then transferred to the Tm³⁺ with an efficiency of > 90%. A Tm:Tm cross relaxation then occurs and transfers this energy to the Ho with a quantum efficiency approaching 2.

Advantages Of Cr,Tm,Ho:YAG Include:

- High-efficiency 2 μm source
- Operates well at room temperature⁽¹⁾
- May be flashlamp or diode pumped
- Laser diode sources can pump the strong 780 nm Tm³⁺ ion absorption line
- Chromium doping not necessary for diode-pumped applications
- Pump line width of 4 nm; 4 times wider than the corresponding Nd:YAG diode-pump line width
- Operates in a relatively eye-safe wavelength range
- Applications in medical, military and scientific lasers

Properties Cr, Tm, Ho:YAG

Lasing Properties

Lasing Transition:	⁵ I ₇ - ⁵ I ₈
Lasing Wavelength	2080 nm
Fluorescence Lifetime	8.5 ms
Stimulated Emission Cross-Section:	7x 10 ⁻²¹ cm ²

Spectral Properties

Index of Refraction:	1.80 (at 2080 nm)
Diode Pump Band:	781 nm
Absorption Linewidth:	4 nm
Major Pump Bands:	400 - 800 nm

Standard Specifications

Material Parameters

Host:	Yttrium Aluminum Garnet (Y ₃ Al ₅ O ₁₂)
Standard Melt Concentration:	Chromium (Cr ³⁺): 0.85 at % Thulium (Tm ³⁺): 5.90 at % Holmium (Ho ³⁺): 0.36 at % (Other Compositions Available)
Orientation:	[111] crystallographic directions ± 5°
Wavefront Distortion:	less than 1/2 wave per inch of length @ 1064 nm

Dimensional Tolerances

Diameter:	+0.000" / -0.002"
Length:	+0.040" / -0.000"
Barrel Finish:	55 ± 5 micro-inch
Chamfer:	0.005" ± 0.003" at 45° ± 5°

End Configuration

Flatness:	within λ / 10 wave at 633 nm wavelength
Parallelism:	within 30 seconds of arc
Perpendicularity:	less than 5 minutes of arc
Surface Quality:	scratch-dig 10 - 5 per MIL-O-13830A

Anti-Reflection End Coatings

Reflectivity:	less than 0.25% at 2080 nm
Adhesion and Durability:	meets MIL-C-48497A standards
Pulsed Damage Threshold:	greater than 10 J / cm ²
Major Pump Bands:	400 - 800 nm

References

1. G. Huber, E. W. Duczynski and K. Petermann, "Laser Pumping of Ho-, Tm-, Er-Doped Garnet Lasers at Room Temperature," *J. Quantum Electronics*, **24**, (1988), 920.
2. T.Y. Fan, G. Huber, R.L. Byer and P. Mitzscherlich, "Spectroscopy and Diode Laser-Pumped Operation of Tm, Ho:YAG," *J. Quantum Electronics*, **24** (1988), 924.

Specifications and information are subject to change without prior notice.
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