

Yb:YAG

Yb:YAG is one of the most promising laser-active materials and more suitable for diode pumping than the traditional Nd-doped systems. Compared with the commonly used Nd:YAG crystal, Yb:YAG crystal has a much larger absorption bandwidth to reduce thermal management requirements for diode lasers, a longer upper-laser level lifetime, three to four times lower thermal loading per unit pump power. Yb:YAG crystal at 1030 nm is a good substitute for a Nd:YAG crystal at 1064 nm and its second harmonic at 515 nm may replace Arion laser (with a large volume), which emit at 514 nm.

Advantages of YB:YAG Crystals

- Very low fractional heating, less than 11%
- Very high slope efficiency
- Broad absorption bands, about 8 nm @ 940 nm
- No excited-state absorption or up-conversion
- Conveniently pumped by reliable InGaAs diodes at 940 nm (or 970 nm)
- High thermal conductivity and large mechanical strength
- High optical quality

Material and Specifications

Dopant concentration	Yb: 0.5~25 at%
Orientation	[100] or [111] within 5°
Wavefront distortion	≤0.125 λ/inch
Extinction ratio	≥28 dB
Rod sizes	diameter: 2~20 mm length: 5~150 mm upon request of customer
Dimensional tolerances	diameter: +0.00"/-0.002" mm length: ±0.02"
Barrel finish	ground finish: 400# grit
Parallelism	≤10"
Perpendicularity	≤5'

Material and Specifications

Flatness	$\lambda/10$
Surface quality	10-5 (MIL-O-13830A)
Chamfer	0.006" \pm 0.002" at 45° \pm 5°
AR coating reflectivity	$\leq 0.25\%$ (@1030 nm)
Single pass loss	$< 3 \times 10^3 \text{ cm}^{-1}$

Optical and Spectral Properties of YB:YAG Crystals

Laser transition	${}^2F_{5/2} \rightarrow {}^2F_{7/2}$
Laser wavelength	1030 nm
Photon energy	$1.93 \times 10^{-19} \text{ J}$ (@ 1030 nm)
Emission linewidth	9 nm
Emission cross section	$2.0 \times 10^{20} \text{ cm}^2$
Fluorescence lifetime	1.2 ms
Diode pump band	940 nm or 970 nm
Pump absorption band width	8 nm
Index of refraction	1.82
Thermal optical coefficient	$9 \times 10^{-6}/^\circ\text{C}$
Loss coefficient	0.003 cm^{-1}

Physical and Chemical Properties

Crystal structure	cubic
Lattice parameters	12.01 Å
Melting point	1970 °C
Moh hardness	8.5
Density	4.56 ± 0.04 g/cm ³
Specific heat (0 – 20)	0.59 J/g.cm ³
Modulus of elasticity	310 GPa
Young's modulus	3.17 × 10 ⁴ Kg/mm ²
Poisson ratio	0.3 (est.)
Tensile strength	0.13 ~ 0.26 GPa
Thermal expansion coefficient	[100] Direction: 8.2 × 10 ⁶ /°C (0~250 °C) [110] Direction: 7.7 × 10 ⁶ /°C (0~250 °C) [111] Direction: 7.8 × 10 ⁶ /°C (0~250 °C)
Thermal conductivity	14 W/m/K (@20 °C) 10.5 W/m/K (@100 °C)
Thermal optical coefficient (d _n /d _t)	7.3 × 10 ⁻⁶ /°C
Thermal shock resistance	790 W/m
Solubility	water: insoluble; common acids: slightly