

## Yb:YAG

### Introduction

**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 1030nm is a good substitute for a Nd:YAG crystal at 1064nm and its second harmonic at 515nm may replace Ar-ion laser (with a large volume), which emit at 514nm.

### Advantages of Yb:YAG Crystal

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

### Material and Specifications

Dopant concentration	Yb: 5~15 at%
Wavefront Distortion	$\leq 0.125 \lambda$ /inch
Extinction Ratio	$\geq 28$ dB
Rod Sizes	Diameter:2~20mm, Length:5~150mm Upon request of customer
Dimensional Tolerances	Diameter:+0.00"/-0.002"mm, Length: $\pm 0.02$ "
Barrel Finish	Ground Finish: 400# Grit
Parallelism	$\leq 10$ "
Perpendicularity	$\leq 5'$
Flatness	$\lambda / 10$
Surface Quality	10-5(MIL-PRF-13830B)
Chamfer	0.006" $\pm$ 0.002" at $45^\circ \pm 5^\circ$
AR Coating Reflectivity	$\leq 0.25\%$ (@1030nm)
Single pass loss	$< 3 \times 10^{-3} \text{cm}^{-1}$

## Optical and Spectral Properties of Yb:YAG Crystal

Laser Transition	${}^2F_{5/2} \rightarrow {}^2F_{7/2}$
Laser Wavelength	1030nm
Photon Energy	$1.93 \times 10^{-19} \text{J} (@1030\text{nm})$
Emission Linewidth	9nm
Emission Cross Section	$2.0 \times 10^{-20} \text{cm}^2$
Fluorescence Lifetime	1.2 ms
Diode Pump Band	940nm or 970nm
Pump Absorption Band Width	8 nm
Index of Refraction	1.82
Thermal Optical Coefficient	$9 \times 10^{-6}/^\circ\text{C}$
Loss Coefficient	$0.003 \text{ cm}^{-1}$