

Nd:YAG - Neodymium Doped Yttrium Aluminum Garnet

Introduction

Neodymium Doped Yttrium Aluminum Garnet (Nd:YAG) is the earliest and most famous laser host crystal. Since it combines great advantages in many basic properties, Nd:YAG is the ubiquitous presence for near-infrared solid-state lasers and their frequency-doubler, tripler, and higher order multiplier.

CASTECH's Nd:YAG is featured by

- High gain
- Low threshold
- High efficiency
- Low loss at 1.06 μm
- Good thermal conductivity and thermal shock characteristics
- Mechanical strength
- high optical quality
- Material characteristics that allow for various modes of operation (CW, pulsed, Q-switched, mode locked)

Table 1. Basic Properties

Crystal Structure	Cubic
Lattice Parameter	12.01 Å
Density	4.5 g/cm ³
Melting Point	1970°C
Reflective Index	1.82
Mohs Hardness	8.5 Mohs
Thermal Expansion Coefficient	$7.8 \times 10^{-6}/\text{K}$ <111>, 0-250°C
Thermal Conductivity	14 W/m/K, 20°C 10.5 W/m/K, 100°C
Stimulated Emission Cross-section	$2.8 \times 10^{-19} \text{ cm}^2$
Relaxation Time of Terminal Lasing Level	30 ns
Fluorescent Lifetime	550 μs
Spontaneous Fluorescence	230 μs
Linewidth	0.6 nm
Loss Coefficient	0.003 cm ⁻¹ @1064 nm

Specifications of Nd:YAG crystal from CASTECH

Table 2. Specifications

Dopant Concentration	Nd: 0.3~2.0 (± 0.1) at.%
Dimension	size up to dia. 15 \times 180 mm and maximum diameter of dia. 40 mm \times 2 mm
Dimensional Tolerances	Diameter: ± 0.1 mm Length: ± 0.5 mm
Surface Quality (Scratch/Dig)	10/5 to MIL-PRF-13830B
Wavefront Distortion	$\lambda/8$ @633 nm
Flatness	$\lambda/8$ @633 nm
Parallelism	20 arc sec
Perpendicularity	≤ 15 arc min
Chamfer	≤ 0.2 mm $\times 45^\circ$
HR Coating	R > 99.8% @1064 nm, R < 5% @808 nm
Other HR Coatings, such as HR-1064/532 nm, HR-946 nm, HR-1319 nm and other wavelengths are available.	
Damage Threshold	> 500 MW/cm ² @1064 nm, 10 ns, 10 Hz (AR-coated)

Table 3. Optical Parameter of Nd:YAG crystal

Diameter (mm)	Standard grade	Excellent grade	Super-excellent grade
Φ3-6.35	≤ 0.5 fringes/inch	≤ 0.25 fringes/inch	≤ 0.1 fringes/inch
	≥ 25 dB	≥ 28 dB	≥ 30 dB
Φ7-10	≤ 0.7 fringes/inch	≤ 0.4 fringes/inch	≤ 0.16 fringes/inch
	≥ 22 dB	≥ 25 dB	≥ 28 dB
Φ11-13	≤ 1 fringes/inch	≤ 0.6 fringes/inch	≤ 0.2 fringes/inch
	≥ 20 dB	≥ 23 dB	≥ 26 dB
Φ14-16	≤ 1.2 fringes/inch	≤ 0.8 fringes/inch	≤ 0.25 fringes/inch
	≥ 18 dB	≥ 20 dB	≥ 23 dB

Higher grade or specific Nd:YAG rods or slabs, and Nd:YAG rods for 946 nm and 1319 nm lasers can be provided. Er:YAG, Yb:YAG and other ion doped YAG crystals are also available upon request.