Photonics On Crystals

POC-OC-122432-Yb:YAG Crystal Datasheet

1 Main Features

- High absorption and emission cross-section with minimal quantum defect (~9%).
- Broad absorption band at 940 nm and emission peak at 1030 nm.
- Excellent thermal conductivity and low thermal lensing, suitable for high-power operations.
- Long fluorescence lifetime of 950 µs, ensuring high energy storage for pulsed lasers.
- High mechanical strength and optical quality for robust performance in demanding environments.

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2. Material General Description

Ytterbium-doped Yttrium Aluminum Garnet (Yb:YAG) is a highly efficient and versatile laser crystal designed for diode-pumped solid-state laser systems. Yb:YAG's simple electronic structure excludes excited-state absorption, resulting in minimal detrimental quenching processes. Compared to the widely used Nd:YAG, Yb:YAG exhibits a broader absorption band near 940 nm, allowing better thermal management and more efficient pump utilization.

Yb:YAG is widely recognized for its high thermal conductivity and mechanical robustness, making it ideal for high-power and thin-disk laser configurations. Its low quantum defect (~9%) significantly reduces heat generation, extending the laser system's lifetime and ensuring stable operation. The

crystal's emission at 1030 nm makes it a strong candidate for replacing Nd:YAG in applications requiring better thermal efficiency.

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3. General Applications and Examples

Yb:YAG crystals are employed across various high-tech industries due to their excellent optical and mechanical properties. Some key applications include:

- **Material Processing**: Yb:YAG lasers are ideal for micromachining, welding, and cutting due to their precision and high energy output. For example, thin-disk laser configurations using Yb:YAG offer unparalleled accuracy in cutting metals and ceramics.
- **Medical Applications**: The crystal's stable operation at 1030 nm enables efficient use in dermatological treatments, surgery, and eye procedures.
- **Defense and Aerospace**: Yb:YAG lasers are utilized for range finding, high-power communication, and advanced targeting systems.
- **Scientific Research**: High-peak power lasers based on Yb:YAG are widely used in femtosecond pulse generation for advanced research applications.
- **Entertainment and Display**: Compact and reliable Yb:YAG lasers are used in holography and projection systems.

Example: Yb:YAG thin-disk lasers enable efficient machining with minimal thermal distortion, making them ideal for intricate manufacturing processes.

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4. Chemical, Physical, or Structural Properties

Property	Specification
Chemical Formula	$Yb:Y_3Al_5O_{12}$
Crystal Structure	Cubic
Lattice Constant (Å)	12.01
Density (g/cm³)	4.56
Melting Point (°C)	1970
Refractive Index (@ 1030 nm)	1.82
Thermal Conductivity	6.2 W/m/K
Thermal Expansion Coefficient	7.8×10^{-6}/K
Mohs Hardness	8.5
Dopant Concentration	0.5–20 atm%

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5. Optical, Laser, or Nonlinear Optical Properties

Property	Specification
Laser Wavelength	1030 nm
Stimulated Emission Cross Section	2.0×10^{-20} cm²
Fluorescence Lifetime	950 µs
Linewidth	9 nm
Loss Coefficient	0.003 cm^{-1}
Absorption Bandwidth	8 nm @ 940 nm
Thermal Optical Coefficient	9×10^{-6}/K

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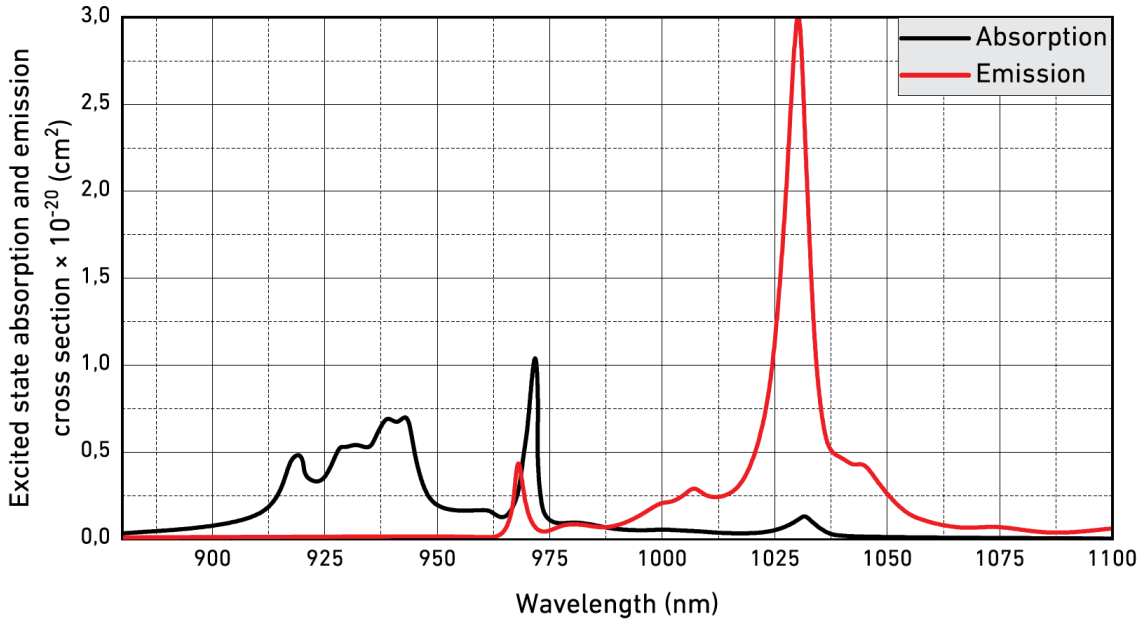
6. Spectrum Transmission Curves

Yb:YAG typically demonstrates high transmittance in the range of 900–1100 nm, peaking near 1030 nm.



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7. Coating Specification

Coating Type	Specification
AR Coating	R < 0.2% @ 1030 nm
HR Coating	R > 99.8% @ 1030 nm
Other Coatings	Available for 940 nm or upon request

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8. Standard Fabrication Specifications

Specification	Value
Dopant Concentration	0.5–20 atm%
Surface Quality	10/5 to MIL-PRF-13830B
Wavefront Distortion	< λ/8 @ 633 nm
Parallelism	< 20 arc seconds
Perpendicularity	< 15 arc minutes
Surface Flatness	< λ/10 @ 633 nm
Chamfer	0.2 mm x 45°
Length Tolerance	±0.5 mm
Diameter Tolerance	±0.1 mm

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9. POC Strength and Capabilities

Photonics On Crystals (POC) delivers high-performance Yb:YAG crystals manufactured to meet the stringent demands of modern laser systems. With state-of-the-art facilities and precision production techniques, POC ensures consistent quality, minimal defects, and optimal performance. Our crystals are customizable for specific applications, offering a range of dopant concentrations, dimensions, and coatings.

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10. Standard Products

Dimension	Length	Dopant (%)	End Faces	Coating	Price (USD)
10 x 10 mm	5 mm	5%	Right-angle cut	AR @ 1030 nm	$540
2 x 2 mm	10 mm	10%	Right-angle cut	AR/HR Coated	$500
5 x 5 mm	15 mm	1%	Brewster-angle	AR @ 940/1030 nm	$600
Customization Available	**Yes**	Upon Request	Upon Request	Upon Request	Upon Request