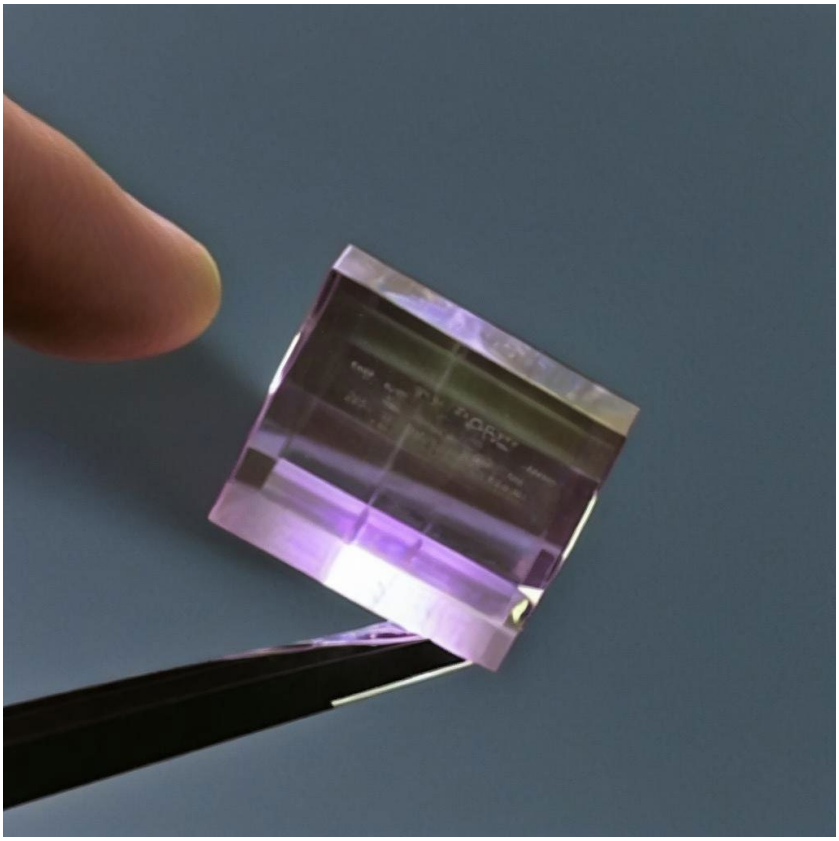
Photonics On Crystals

POC-OC-122426-Nd:YVO4 Crystal Datasheet

1 Main Features

1. **High Absorption Coefficient**: Up to five times higher absorption efficiency over a wide pump wavelength range (~808 nm) compared to Nd:YAG.
2. **Large Stimulated Emission Cross-Section**: Up to three times higher at 1064 nm, offering superior lasing performance.
3. **Low Pump Threshold**: Enables higher slope efficiency for diode-pumped lasers.
4. **Linearly Polarized Emission**: Emission is linearly polarized due to uniaxial birefringence, eliminating undesired birefringent effects.
5. **Wide Operating Wavelengths**: Supports lasing at 1064 nm (IR) and 1342 nm for advanced applications.



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2. Material General Description

Neodymium Doped Yttrium Orthovanadate (Nd:YVO4) is a highly efficient laser host crystal widely used in diode-pumped solid-state lasers, particularly for low to medium power density applications. Its absorption and emission properties surpass those of Nd:YAG, making it a superior choice for compact and efficient laser systems.

Nd:YVO4 features a wide absorption bandwidth (~808 nm), enabling efficient energy absorption even with non-ideal laser diode wavelengths. The crystal is also known for its large stimulated

emission cross-section, which supports high-power output and superior performance in continuous-wave (CW) and pulsed laser systems. Additionally, the uniaxial birefringence of Nd:YVO4 ensures linearly polarized emission, enhancing efficiency for frequency-doubling processes when combined with nonlinear crystals like LBO or KTP.

Nd:YVO4-based lasers are extensively used in a variety of applications, including precision machining, medical diagnostics, spectroscopy, and laser displays. With its compact design and high quantum efficiency, Nd:YVO4 is rapidly replacing traditional lamp-pumped laser systems in modern applications.

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3. General Applications and Examples

Nd:YVO4 crystals are widely used in advanced laser systems due to their superior performance characteristics. Examples include:

1. Industrial Applications

- **Laser Cutting and Engraving**: High-power Nd:YVO4 lasers are used in precision machining for metal and non-metal materials.
- **Example**: Compact diode-pumped Nd:YVO4 lasers enable precise cutting and engraving of intricate patterns in electronic components.

2. Medical Applications

- **Surgical Lasers**: Nd:YVO4 lasers operating at 1064 nm are used in soft-tissue surgeries and dermatological treatments.
- **Example**: Nd:YVO4 laser systems deliver high-power, minimally invasive treatments with high precision.

3. Spectroscopy

- **Fluorescence Excitation**: High-energy Nd:YVO4 lasers are used in Raman and fluorescence spectroscopy for material and biochemical analysis.
- **Example**: Nd:YVO4 lasers with linearly polarized emission improve signal-to-noise ratios in spectroscopy systems.

4. Display and Projection

- **Laser Displays**: High-frequency Nd:YVO4 lasers enable vivid laser projections in entertainment and visualization applications.
- **Example**: Compact green lasers using Nd:YVO4 as the gain medium and KTP for frequency doubling are widely used in stage lighting.

5. Scientific Research

- **Quantum Optics**: Nd:YVO4 lasers serve as reliable sources for experiments in quantum mechanics and photonics.
- **Example**: High-precision Nd:YVO4 lasers are used in quantum communication and entanglement experiments.

4. Chemical and Structural Properties

Property	Value
Chemical Formula	Nd:YVO4
Crystal Structure	Zircon Tetragonal, Space Group D4h-14/amd
Lattice Constants	a = b = 7.12 Å, c = 6.29 Å
Density	4.22 g/cm³
Mohs Hardness	4–5 (Glass-like)
Thermal Expansion	a = 4.43 × 10^{-6} /K at 300 K; c = 11.37 × 10^{-6} /K
Thermal Conductivity	a = 5.23 W/m·K; c = 5.10 W/m·K
Transparency Range	~400 nm to 5 µm

5. Optical and Laser Properties

Property	Value
Lasing Wavelengths	1064 nm (IR), 1342 nm
Thermal Optical Coefficient	dn/dT = 8.5 × 10^{-6} /K (n_o), dn/dT = 2.9 × 10^{-6} /K (n_e)
Stimulated Emission Cross-Section	25 × 10^{-19} cm² at 1064 nm
Fluorescent Lifetime	90 µs (1% Nd doping)
Absorption Coefficient	31.4 cm^{-1} at 808 nm
Intrinsic Loss	0.02 cm^{-1} at 1064 nm
Gain Bandwidth	0.96 nm at 1064 nm
Polarized Laser Emission	π-Polarization, parallel to optical c-axis
Diode Pumped Efficiency	>60%

6. Spectrum Transmission Curves

Nd:YVO4 crystals exhibit high transparency over a wide range, from visible to infrared wavelengths (400 nm to 5 µm). A typical absorption curve for 0.5% Nd:YVO4 indicates efficient energy absorption at 808 nm for diode pumping, with minimal absorption losses across other wavelengths.

(*Graphical data available upon request.*)

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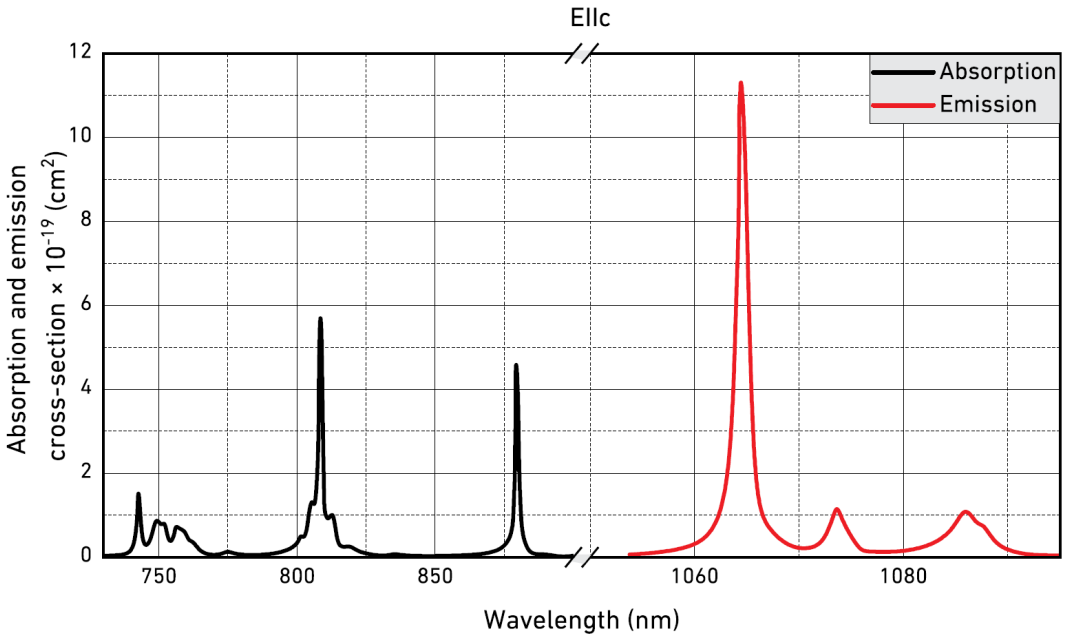
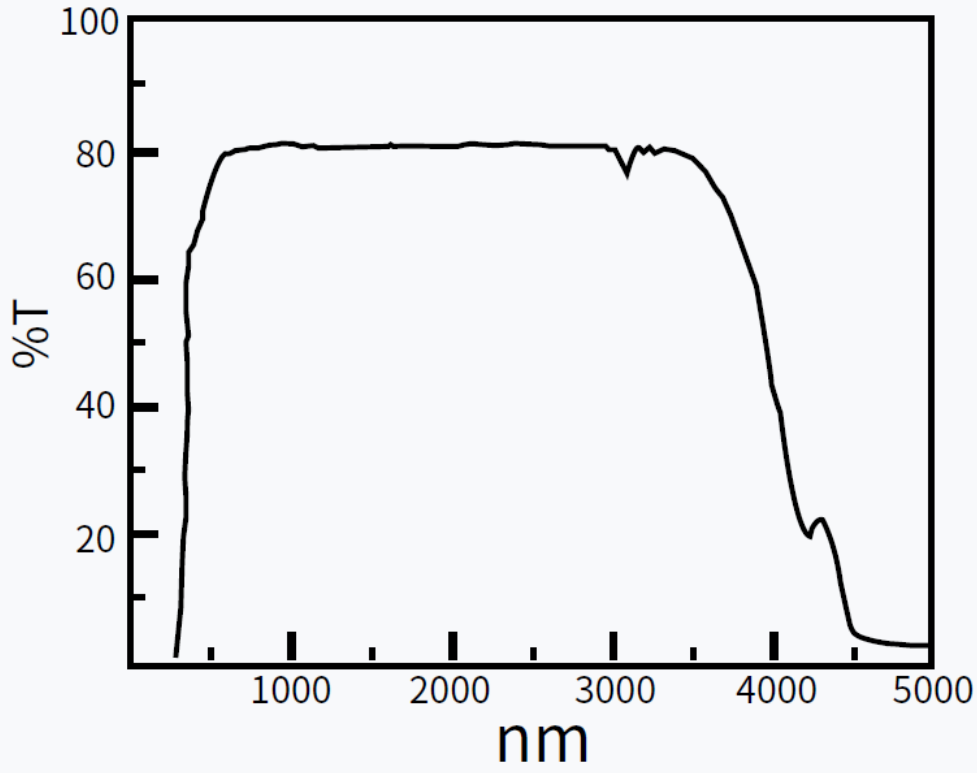
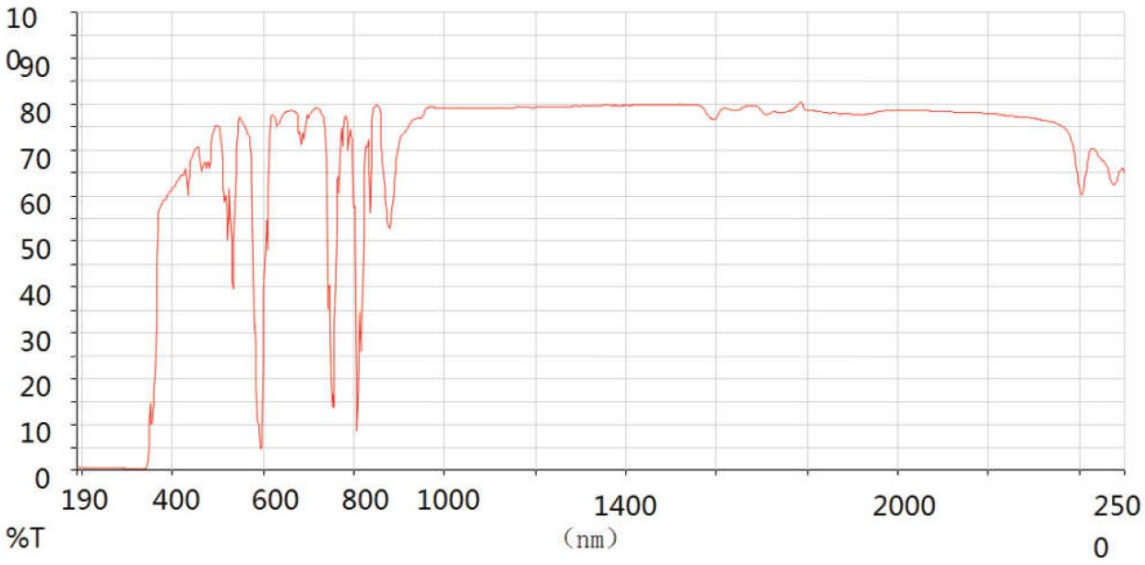




Transparency Curve for Nd:YVO_4 (Thickness=1mm)



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7. Coating Specification

Coating Type	Specifications
AR Coating	R < 0.2% at 808 nm; R < 0.1% at 1064 nm
Custom Coatings	Gold or chrome plated; available on request

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8. Standard Fabrication Specifications

Specification	Value
Dimension Tolerance	±0.1 mm (standard); ±0.005 mm (high precision)
Clear Aperture	Central 95% of the diameter
Surface Quality	20-10 Scratch-Dig
Surface Flatness	λ/8 at 633 nm
Parallelism	<10 arc seconds
Perpendicularity	<5 arc minutes
Chamfer	0.1 mm at 45°
Damage Threshold	>15 J/cm² (10 ns, 10 Hz at 1064 nm)

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9. POC Strength and Capabilities

Photonics On Crystals (POC) is a leader in the fabrication and customization of high-quality Nd:YVO4 crystals for advanced photonics applications. Key strengths include:

- **Customization**: Tailored sizes, doping concentrations, and coatings to meet specific user requirements.
- **Precision Manufacturing**: High-precision fabrication ensures consistency and reliability for all crystals.
- **Technical Support**: Expert guidance for integrating Nd:YVO4 crystals into laser systems.

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10. Standard Products

Product Code	Dimensions (mm)	Doping Level (Nd)	Coating	Price (USD)
NDYVO4-01	3 × 3 × 0.5	1.0%	AR @ 808 nm / 1064 nm	Request Quote
NDYVO4-02	6 × 6 × 1	1.0%	Customizable	Request Quote
NDYVO4-03	10 × 10 × 2	0.5%	Customizable	Request Quote
Custom-NDYVO4	Customizable	Customizable	Customizable	Request Quote