HG Optronics., INC

Professional Manufacture of Crystals Over 12 years

一. Nd:YLF

Nd:YLF is an excellent crystal for modelocked operation because it combines the characteristics of weak thermal lensing, large fluorescence line width and naturally polarized oscillation.

■ Advantages of Nd:YLF Crystals：

High power, low beam divergence, efficient single mode operation

High average power Q-switching at a moderate repetition rate

Linear polarized resonators for Q-switching and frequency doubling

Potential uniform mode for large diameter rods or slabs

Stimulated emission cross section is favorable for low CW threshold

Thermal lensing lower than that of YAG

1053nm output of Nd:YLF matches gain curves of Nd:Glass and performs well as an oscillator and pre-amplifier for this host.

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恒光光电 HGOPTRONICS

■ Specifications

Dopant concentration	Nd: ~1.0 at%
Orientation	[100] or [001] within 5°
Wavefront distortion	≤0.25λ/inch @632.8nm
Rod sizes	Diameter 3~8mm, Length 10~120mm Upon request of customer
Dimensional tolerances	Diameter: +0.00/-0.05mm, Length: ± 0.5mm
Barrel finish	Ground or polished
Parallelism	≤ 10"
Perpendicularity	≤ 5'
Flatness	≤ λ/10@632.8nm
Surface quality	10-5 (MIL-O-13830B)
Chamfer	0.15±0.05mm
AR coating reflectivity	≤0.25%@1047/1053nm

■ Physical and Chemical Properties

Crystal Structure	Tetragonal
Melting Point	825℃
Moh Hardness	4-5
Density	3.95g/cm^3
Young's Modulus	7.5×10^{11}dynes cm^{-2}
Tensile Strength	3.3×10^{8}dynes cm^{-2}
Thermal Expansion Coefficient	[100]Direction:13×10^{-6}/K
	[001]Direction:8×10^{-6}/K
Thermal Conductivity	0.06W/cm/K

■ **Optical and Spectral Properties**

Laser transition	$^4F_{3/2} \rightarrow {}^4I_{11/2}$
Laser wavelength	1047nm, 1053nm
Emission cross section	$1.8\times10^{-19}cm^2$(E∥C) @1047nm $1.2\times10^{-19}cm^2$(E⊥C) @1053nm
Fluorescence lifetime	485μs (1.0at%Nd)
Index of refraction	n_o=1.443 n_e=1.464 @633nm n_o=1.448 n_e=1.470 @1064nm

二. Tm:YLF

Tm:YLF is the important middle infrared laser crystal. Because Tm:YLF is negative uniaxial crystal, whose thermal refractive index coefficient is negative, some thermal distortion may be counteracted and high-quality light can be output. Conveniently pumped at 792nm, 1.9μm linearly polarized beam is output in a axis, and non-linearly polarized beam is output in c axis.

■ Advantages of Tm:YLF Crystals：

Linearly polarized output beam

Little heat effect while laser

Effective cross relaxing of Tm ions

Relatively high efficiency with LD pumping

■ Specifications

Dopant concentration	Tm: 0~5at% Upon request of customer
Orientation	[100] or [001] within 5º
Wavefront distortion	≤0.25λ/25mm @632.8nm
Rod sizes	Diameter 3~9.5mm, Length 5~120mm Upon request of customer (rod or slab)
Dimensional tolerances	Diameter:+0.00/-0.05mm , Length: ± 0.5mm
Barrel finish	Ground or polished
Parallelism	≤10"
Perpendicularity	≤5'
Flatness	≤ λ/10@632.8nm
Surface quality	10-5 (MIL-O-13830B)
Chamfer	0.15±0.05mm
AR coating reflectivity	≤0.25%

■ Optical and Spectral Properties

Laser transition	$^3F_4 \rightarrow {}^3H_6$
Laser wavelength	1.9μm
Index of refraction	n_o=1.443 n_e=1.464 @633nm n_o=1.448 n_e=1.470 @1064nm

■ **Physical and Chemical Properties**

Crystal Structure	Tetragonal
Melting Point	825℃
Moh Hardness	4-5
Density	3.95g/cm^3
Thermal Conductivity	0.06W/cm/K
Young's Modulus	7.5×10^{11}dynes cm^{-2}
Tensile Strength	3.3×10^{8}dynes cm^{-2}
Thermal Expansion Coefficient	[100] Direction:13×10^{-6}/K
	[001] Direction:8×10^{-6}/K

三. Ho:YLF

Ho:YLF is the important middle infrared laser crystal. Ho:YLF pumped ZGP crystal at 1.9μm, so 2.05μm linearly polarized beam can be output.

■ Advantages of Ho:YLF Crystals：

Linearly polarized output beam

Little heat effect while laser

Conveniently pumped at 1.9μm

■ Specifications

Dopant concentration	Ho: 0~3at% Upon request of customer
Orientation	[100] or [001] within 5º
Wavefront distortion	≤0.25λ/25mm @632.8nm
Rod sizes	Diameter 3~9.5mm, Length 5~120mm Upon request of customer (rod or slab)
Dimensional tolerances	Diameter:+0.00/-0.05mm , Length: ± 0.5mm
Barrel finish	Ground or polished
Parallelism	≤10"
Perpendicularity	≤5'
Flatness	≤ λ/10@632.8nm
Surface quality	10-5 (MIL-O-13830B)
Chamfer	0.15±0.05mm
AR coating reflectivity	≤0.25%

■ Optical and Spectral Properties

Laser transition	$^5I_7 \rightarrow {}^5I_8$
Laser wavelength	2.05μm
Index of refraction	n_o=1.443 n_e=1.464 @633nm n_o=1.448 n_e=1.470 @1064nm

■ **Physical and Chemical Properties**

Crystal Structure	Tetragonal
Melting Point	825℃
Moh Hardness	4-5
Density	3.95g/cm^3
Thermal Conductivity	0.06W/cm/K
Young's Modulus	7.5×10^{11}dynes cm^{-2}
Tensile Strength	3.3×10^{8}dynes cm^{-2}
Thermal Expansion Coefficient	[100] Direction:13×10^{-6}/K
	[001] Direction:8×10^{-6}/K

四. Pr:YLF

Only few laser materials have necessary properties for realization of lasing in visible spectral range. Trivalent praseodymium (Pr^{3+}) is known to be an interesting laser ion for using with solid-state lasers in the visible spectral range because of its energy levels scheme, providing several transitions in the red (640 nm, $^3P_0$ to $^3F_2$), orange (607 nm, $^3P_0$ to $^3H_6$), green (523 nm, $^3P_0$ to $^3H_5$), and dark-red (720 nm, $^3P_0$ $^3F_3$ $^3F_4$) spectral regions. Pr^{3+}:YLF has been found as promising laser material for producing visible lasers directly.

■ **Specifications**

Orientation	a-cut
Clear aperture	>90%
Face dimensions tolerance	+0/-0,1 mm

Length tolerance	±0,1 mm
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 (MIL-O-138 30 B)
Coatings	AR(R<1%)@440-444 nm + AR(R<0,6%)@500-700 nm on both faces
Laser induced damage threshold	>5 J/cm^2@532 nm, 10 ns

■ **Physical and Chemical Properties**

Typical doping level	**0,1-0,25 at.%**
Absorption peak wavelength	~500 nm
Absorption peak wavelength	
Absorption cross-section at peak wavel ength	38 ×10-20 cm^2
Laser wavelength	790 (670-1070) nm
Lifetime of energy level	3,2 μs
Emission cross-section	@790 nm 41 ×10^{-20} cm^2
Refractive index	@800 nm 1,76
Crystal structure	hexagonal
Density	3,98 g/cm^3
Mohs hardness	9
Thermal conductivity	33 Wm^{-1} K^{-1}
dn/dT	13 ×10^{-6} K^{-1}
Thermal expansion coefficient	5 ×10-6 K^{-1}

五. Yb^{3+}:YLF

Yb^{3+}:YLF laser crystals have better thermo-optical properties than isotropic host like YAG, its large thermal conductivity provides efficient heat extraction. Moreover, Yb^{3+}:YLF has wide emission cross-section, with peak value at the lasing wavelength comparable to that found in $Yb^{3+}:Sr_3Y(BO_3)_3$ and $Yb^{3+}:Ca_4GdO(BO_3)_3$ laser crystals.. Also, YLF crystal has advantage by ytterbium ions to be doped to a high degree.

■ **Specifications**

Orientation	**a-cut**
Clear aperture	>90%
Face dimensions tolerance	+0/-0,1 mm
Length tolerance	±0,1 mm
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 (MIL-O-138 30 B)
Coatings	AR(R<0,5%)@960 nm + AR(R< 0,15%)@1000-1060 nm on both faces
Laser induced damage threshold	>10 J/cm2@1030 nm, 10 ns

■ **Physical and Chemical Properties**

Typical doping level	**5-20 at.%**
Absorption peak wavelength	960 nm
Absorption cross-section at peak wavel ength	$10{,}5 \times 10^{-21}$ cm^2
Laser wavelength	1017 nm
Lifetime of energy level	2,1 ms
Emission cross-section @1053 nm	$4{,}1 \times 10^{-21}$ cm^2
Refractive index @1040nm	~1,4
Crystal structure	tetragonal
Density	3,95 g/cm^3
Mohs hardness	5
Thermal conductivity	6 $Wm^{-1}K^{-1}$
dn/dT	$-4{,}6 \times 10^{-6}$ (IIc) K^{-1}, $^{-6}$,6×10^{-6} (IIa) K^{-1}
Thermal expansion coefficient	8×10^{-6} (IIc) K^{-1}, 13×10^{-6} (IIa) K^{-1}