

# Nd:YLF - Neodymium Doped Yttrium Lithium Fluoride (Nd:YLiF<sub>4</sub>)

## Introduction

CASTECH grows Nd:YLF crystals using Czochralski method. The use of high quality starting materials for crystal growth, whole boule interferometry, and precise inspection of scattering particle in crystal using He-Ne laser assure that each crystal will perform well.

## CASTECH's general Nd:YLF production capabilities including

- Rod sizes from 2 mm to 10 mm in diameter and from 1 mm to 150 mm in length
- Orientation of rod axis to crystal axis <1 degree
- Polished only or AR coated rods
- Nd dopant concentrations between 0.4 and 1.2 at%
- Large rod and slab dimensions and non-standard dopant concentrations are available upon request

Table 1. Basic Properties

Chemical Formula	LiY <sub>1.0-x</sub> Nd <sub>x</sub> F <sub>4</sub>
Crystal Structure	Tetragonal
Space Group	I4 <sub>1</sub> /a
Nd atoms / cm <sup>3</sup>	1.40 × 10 <sup>20</sup> atoms/cm <sup>3</sup> for 1% Nd doping
Modulus of Elasticity	85 GPa
Lattice Parameter	a = 5.16 Å, c = 10.85 Å
Melting Point	819°C
Mohs Hardness	4~5 Mohs
Density	3.99 g/cm <sup>3</sup>
Thermal Conductivity	0.063 W/cm/K
Specific Heat	0.79 J/g/K
Thermal Expansion Coefficient	8.3 × 10 <sup>-6</sup> /K // c, 13.3 × 10 <sup>-6</sup> /K ⊥ c

Table 2. Optical Properties

Transparency Range	180-6700 nm
Peak Stimulated Emission Cross Section	$1.8 \times 10^{-19} / \text{cm}^2$ (E // c) at 1047 nm $1.2 \times 10^{-19} / \text{cm}^2$ (E $\perp$ c) at 1053 nm
Fluorescence Lifetime	485 $\mu\text{s}$ for 1% Nd doping
Scatter Losses	<0.2% /cm
Peak Absorption Coefficient (for 1.2% Nd)	$\alpha = 10.8 \text{ cm}^{-1}$ (792.0 nm E // c) $\alpha = 3.59 \text{ cm}^{-1}$ (797.0 nm E $\perp$ c)
Laser Wavelength	1047 nm (// c, a-cut crystal) 1053 nm ( $\perp$ c, a or c-cut crystal)
Sellmeier Equations ( $\lambda$ in $\mu\text{m}$ ):	
$n_o^2 = 1.38757 + 0.70757\lambda^2 / (\lambda^2 - 0.00931) + 0.18849\lambda^2 / (\lambda^2 - 50.99741)$	
$n_e^2 = 1.31021 + 0.84903\lambda^2 / (\lambda^2 - 0.00876) + 0.53607\lambda^2 / (\lambda^2 - 134.9566)$	

Table 3. Index of Refraction

Wavelength (nm)	$n_o$	$n_e$
262	1.485	1.511
350	1.473	1.491
525	1.456	1.479
1050	1.448	1.47
2065	1.442	1.464

Table 4.  $dn / dT$ 

Wavelength (nm)	E // c	E $\perp$ c
436	$-2.44 \times 10^{-6} / ^\circ\text{C}$	$-0.54 \times 10^{-6} / ^\circ\text{C}$
578	$-2.86 \times 10^{-6} / ^\circ\text{C}$	$-0.91 \times 10^{-6} / ^\circ\text{C}$
1060	$-4.30 \times 10^{-6} / ^\circ\text{C}$	$-2.00 \times 10^{-6} / ^\circ\text{C}$

## Specifications of Nd:YLF crystal from CASTECH

Table 5. Specifications

Standard Dopant Concentration	Nd: $1.1 \pm 0.1\%$
Surface quality (scratch/dig)	10/5 to MIL-PRF-13830B
Wavefront Distortion	$\leq \lambda/4$ @633 nm
Surface Flatness	$\lambda/8$ @633 nm
Parallelism	20 arc sec
Perpendicularity	$\leq 15$ arc min
Chamfer	$\leq 0.2 \text{ mm} \times 45^\circ$
End Coating	R<0.15% @1047/1053 nm