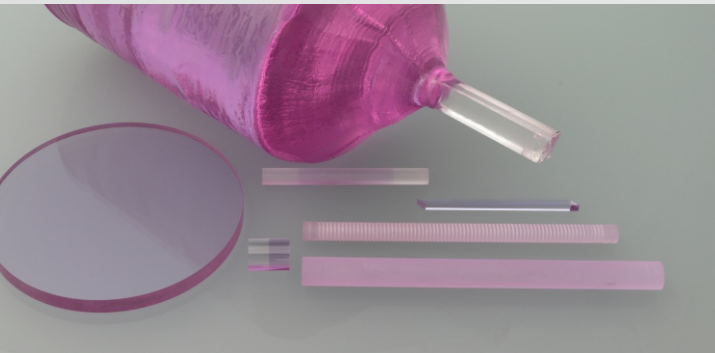


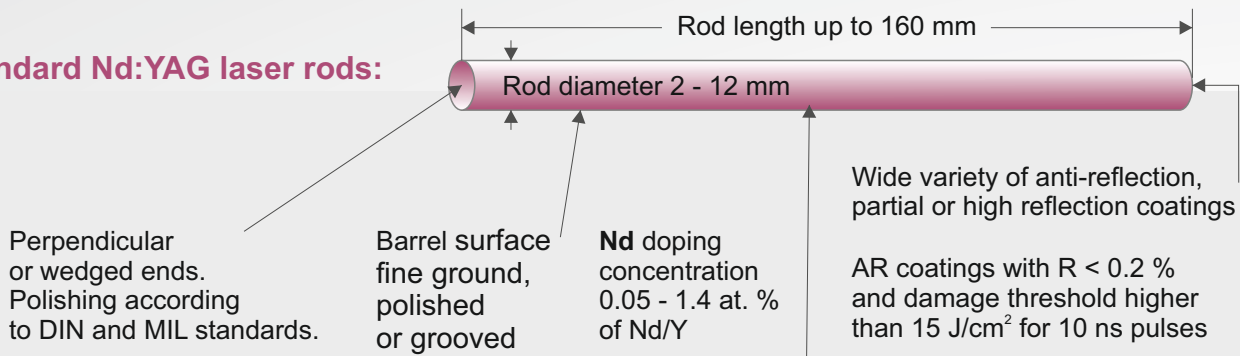
Nd:YAG

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CRYTUR grows neodymium doped yttrium aluminium garnet (Nd:YAG) crystals using the Czochralski growth method. A special protective atmosphere applied during crystal growth and post-growth annealing result in a very good lasing efficiency of our crystals. Our production line covers crystal growth, machining and coating technologies.

Standard Nd:YAG laser rods:

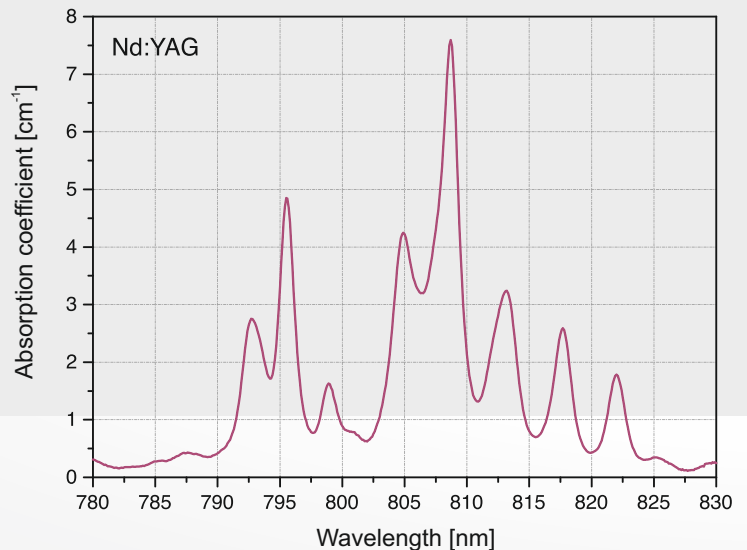


We also offer composite laser rods consisting of doped and undoped segments. These composite rods help to decrease thermal lensing and other thermal stress-induced effects, particularly when used in axially diode pumped resonators.

Nd:YAG material properties

Host	Yttrium Aluminium Garnet ($\text{Y}_3\text{Al}_5\text{O}_{12}$)
Dopant	Nd^{3+}
Crystal structure	cubic - Ia3d
Unit cell dimensions	$a_c = 1.201 \text{ nm}$
Refractive index at 1064 nm	1.816
Thermal expansion coefficient	$7.8 \times 10^{-6} / \text{K}$
Thermal conductivity	11 W/m K
Density	4.56 g/cm ³
Mohs hardness	8.25
Fluorescence lifetime (1 at % Nd)	235 μs
Linear dispersion $\delta n / \delta T$	$9.86 \cdot 10^{-6} \text{ K}^{-1}$
Pump wavelength	808 nm

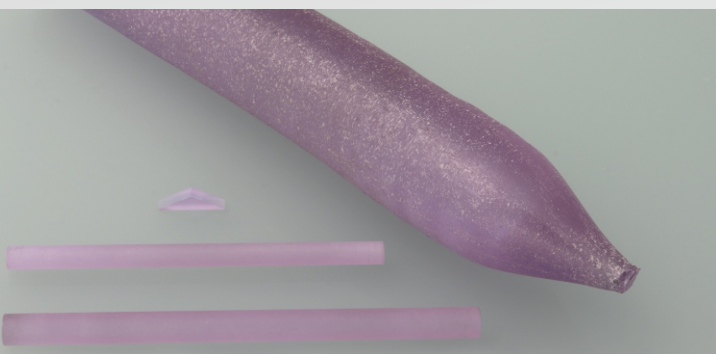
Absorption spectrum of Nd:YAG



Laser wavelengths	${}^4\text{F}_{3/2} \rightarrow {}^4\text{I}_{9/2}$	946 nm		
	${}^4\text{F}_{3/2} \rightarrow {}^4\text{I}_{11/2}$	1064 nm		
	${}^4\text{F}_{3/2} \rightarrow {}^4\text{I}_{13/2}$	1319 nm		
	${}^4\text{F}_{3/2} \rightarrow {}^4\text{I}_{13/2}$	1444 nm		
Emission cross section [10^{-19} cm^2]	1064 nm	1319 nm	1444 nm	
	3.8	0.95	0.45	

Nd:YAP

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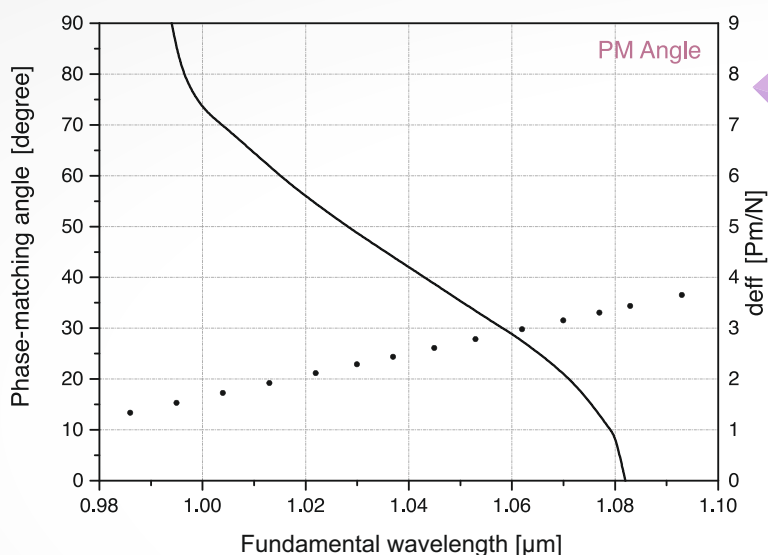
Our standard production of Nd:YAP laser rods includes Nd dopant concentrations from 0.25 % up to 1.1 at. % of Nd/Y. Nd:YAP laser rods with 0.7 at. % Nd/Y are typically used for CW and 0.9 at. % Nd/Y for pulsed lasers, both with the “b” orientation.

The threshold and slope efficiency of Nd:YAP at 1079 nm are comparable to those of Nd:YAG at 1064 nm. Rods cut along the “b” axis are suited for most applications.

Linear polarization, no thermal birefringence and easy generation of 1.3 μm wavelength are the main

advantages of this material. The 1340 nm emission wavelength of Nd:YAP has higher absorption in water and bodily fluids in comparison with the 1319 nm emission wavelength of Nd:YAG.

Taking into account the polarized output beam, Nd:YAP can be advantageously utilized in lasers with electro optic cells or harmonic generators. The wavelength of 1079 nm emitted by Nd:YAP can realize type II non-critical phase matching in an α -cut KTP crystal, where the effect of beam walk-off is eliminated and the conversion efficiency is increased compared to angular phase-matching.



Nd:YAP material properties

Host	Yttrium Aluminium Perovskite (YAIO_3)
Dopant	Nd^{3+}
Crystal structure	orthorhombic - Pbnm
Unit cell dimensions (Pbnm notation)	$a_0 = 0.518 \text{ nm}$
	$b_0 = 0.531 \text{ nm}$
	$c_0 = 0.736 \text{ nm}$
	$1.914 (n_a)$
Refractive index at 1064 nm	$1.925 (n_b)$
	$1.940 (n_c)$

Thermal expansion coefficient	$\parallel a: 9.5 \times 10^{-6} / \text{K}$
	$\parallel b: 4.3 \times 10^{-6} / \text{K}$
	$\parallel c: 10.8 \times 10^{-6} / \text{K}$
Thermal conductivity	11 W/m K
Density	5.35 g/cm^3
Mohs hardness	8.5
Fluorescence lifetime (1 at. % Nd)	170 μs
Linear dispersion $\delta n / \delta T$	$9.7 (n_a) 10^{-6} \text{K}^{-1}$

Laser wavelengths

$^4\text{F}_{3/2} \rightarrow ^4\text{I}_{9/2}$	930 nm
$^4\text{F}_{3/2} \rightarrow ^4\text{I}_{11/2}$	1079 nm
$^4\text{F}_{3/2} \rightarrow ^4\text{I}_{13/2}$	1340 nm
$^4\text{F}_{3/2} \rightarrow ^4\text{I}_{13/2}$	1432 nm



CRYTUR, spol. s r.o. | Na Lukách 2283 | 511 01 Turnov | Czech Republic



+420 481 319 511



+420 481 322 323



sales@crytur.cz



www.crytur.com

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Emission cross sections of Nd:YAP in dependence on its crystallographic orientation.

(Ref. A. A. Kaminskii, *Laser Crystals*, New York: Springer Verlag 1981).

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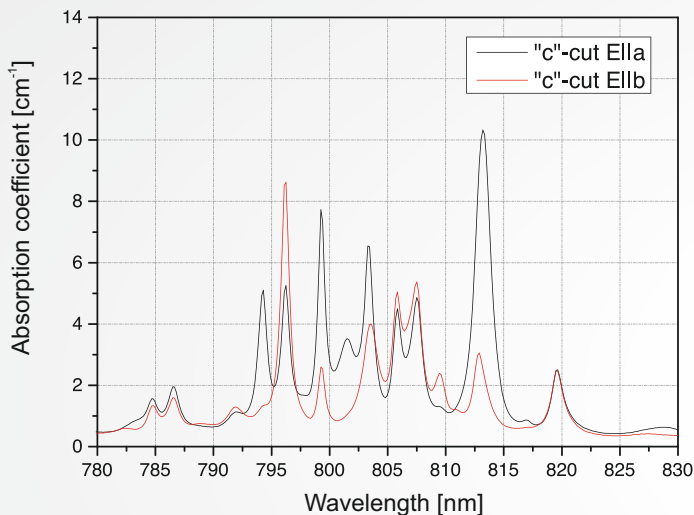


Nd:YAP

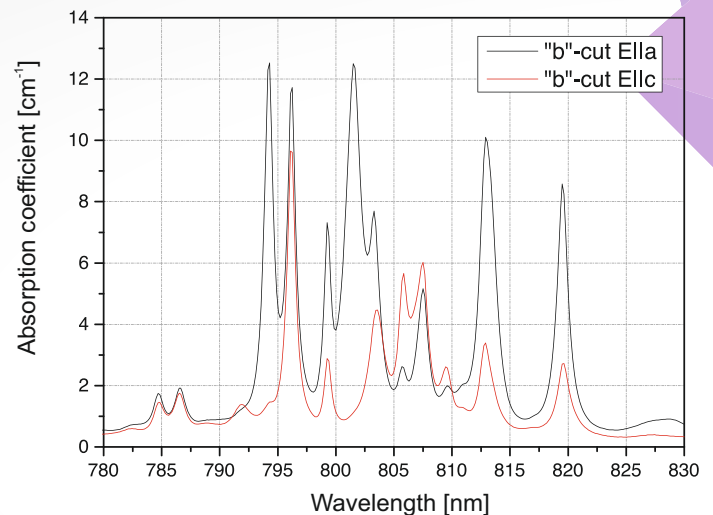
Wavelength [nm]	Emission cross section [10^{-19} cm^2]		
	"a"-cut	"b"-cut	"c"-cut
1079	2.05	1.76	1.38
1340	1.13	0.97	0.78
1432		0.34	

The main absorption line of the Nd:YAG crystal occurs at 808 nm. In case of Nd:YAP the peak of the absorption depends on crystallographic direction of Nd:YAP and polarization.

Absorption spectrum of "c"-cut Nd:YAP in polarized light



Absorption spectrum of "b"-cut Nd:YAP in polarized light



Absorption spectrum of Nd:YAP in unpolarized light

