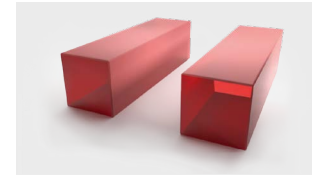


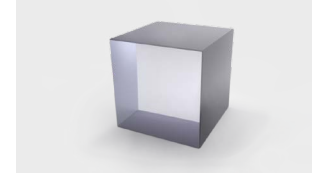
Laser crystals

Laser crystals, glasses and ceramics are used as optical gain sources in solid-state lasers. These media are typically doped with rare-earth ions (e.g. neodymium, ytterbium, or erbium) or transition metal ions (titanium or chromium).

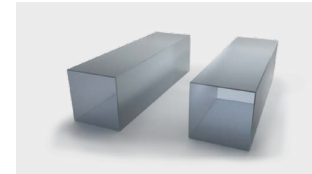
4Lasers develops and supplies different laser crystal hosts and ion dopant combinations for fundamental, applied research and industrial applications. Available crystal growth techniques: Stepanov, Modified Flux growth, Kyropoulos and Czochralski.



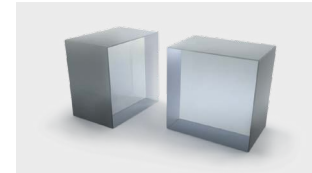
Ti:Sapphire crystals



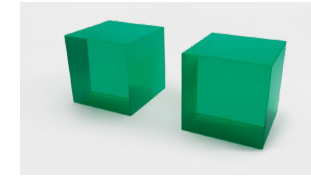
Ho:YLF crystals



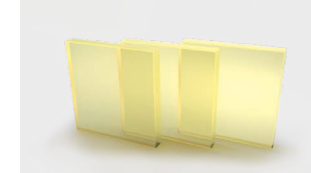
Yb-doped crystals



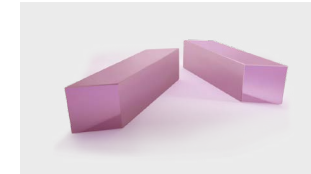
Tm-doped crystals



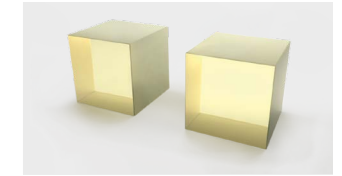
Cr:LiSAF crystals



Tm, Ho:KYW crystals



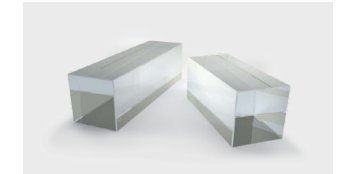
Er-doped crystals



Pr:YLF crystals

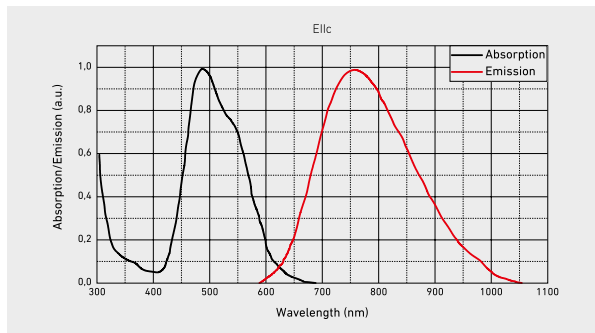
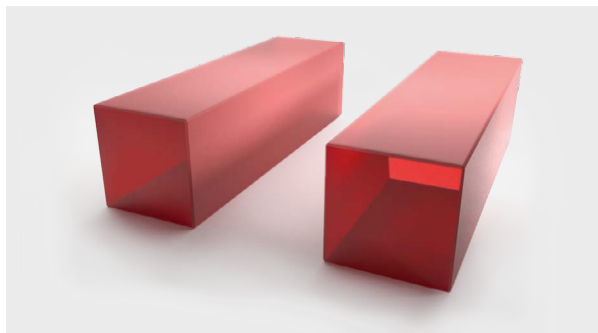


Nd-doped crystals



Er, Yb co-doped crystals

Ti:Sapphire crystals



Titanium-doped sapphire ($\text{Ti}^{3+}:\text{Al}_2\text{O}_3$) is a widely used transition-metal-doped laser crystal. Ti^{3+} ion has a very large gain bandwidth, that opens possibility to obtain very wide wavelength tunability realized in short pulse lasers. To obtain crystals with good optical quality Ti^{3+}

doping concentration should not exceed 0,25 at.%. Ti:Sapphire crystal is characterized by a short upper-state lifetime and a high saturation power. All these properties lead to the necessity of using a strongly focused pump beam.

Main features

- Excellent thermal conductivity
- Broad gain bandwidth
- Wide range of possible pump wavelengths (typically 532 nm)
- Custom crystals available upon request

Application examples

- Mode-locked lasers with ultrashort pulses
- Multi-pass amplifiers and regenerative amplifiers

Standard specifications

TI:SAPPHIRE CRYSTALS	
Orientation	a-cut
Absorption	90-95% of 532 nm pump radiation
Figure of merit	>150 [for 15 mm and longer crystals]
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<30 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,15 mm at 45°
Surface quality	10-5 S-D
Surface flatness	<λ/10@632,8 nm [for 6x6 mm and smaller crystals]
Wavefront distortion	λ/4@632,8 nm
Coatings	AR[R<1%]@532 nm + AR[R<0,3%]@750-850 nm on both faces
LIDT	>2 J/cm²@800 nm, 300 ps
Mount	Unmounted

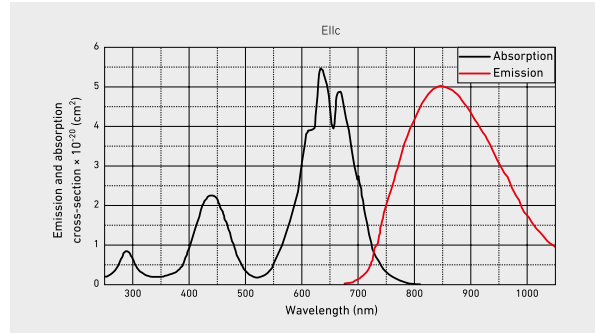
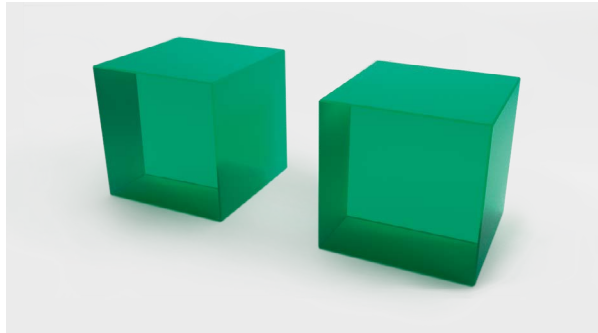
Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	~500 nm
Absorption cross-section at peak wavelength	$38 \times 10^{-20} \text{ cm}^2$
Laser wavelength	790 (670-1070) nm
Lifetime of energy level	3,2 μs
Emission cross-section @790 nm	$41 \times 10^{-20} \text{ cm}^2$
Refractive index @800 nm	1,76
Crystal structure	hexagonal
Density	3,98 g/cm³
Mohs hardness	9
Thermal conductivity	$33 \text{ Wm}^{-1} \text{ K}^{-1}$
dn/dT	$13 \times 10^{-6} \text{ K}^{-1}$
Thermal expansion coefficient	$5 \times 10^{-6} \text{ K}^{-1}$
Typical doping level	0,1-0,25 at.%

Standard products

FACE DIMENSIONS	LENGTH	END FACES	COATINGS	SKU	PRICE
3 x 3 mm	5 mm	Brewster-angle cut	Uncoated	6633	880 €
3 x 3 mm	5 mm	Right-angle cut	AR/AR@532 nm + 750-850 nm	6632	980 €
6 x 6 mm	7 mm	Brewster-angle cut	Uncoated	6635	980 €
6 x 6 mm	7 mm	Right-angle cut	AR/AR@532 nm + 750-850 nm	6634	1080 €
6 x 6 mm	10 mm	Brewster-angle cut	Uncoated	6637	980 €
6 x 6 mm	10 mm	Right-angle cut	AR/AR@532 nm + 750-850 nm	6636	1080 €
6 x 6 mm	15 mm	Brewster-angle cut	Uncoated	6639	1080 €
6 x 6 mm	15 mm	Right-angle cut	AR/AR@532 nm + 750-850 nm	6638	1180 €
ø6 mm	20 mm	Brewster-angle cut	Uncoated	6641	1080 €
ø6 mm	20 mm	Right-angle cut	AR/AR@532 nm + 750-850 nm	6648	1180 €
ø12 mm	15 mm	Right-angle cut	AR/AR@532 nm + 750-850 nm	6640	2150 €
ø16 mm	20 mm	Right-angle cut	AR/AR@532 nm + 750-850 nm	6642	3950 €
ø20 mm	25 mm	Right-angle cut	AR/AR@532 nm + 750-850 nm	6643	4950 €
ø30 mm	25 mm	Right-angle cut	AR/AR@532 nm + 750-850 nm	6644	Request
ø40 mm	25 mm	Right-angle cut	AR/AR@532 nm + 750-850 nm	6645	Request
ø50 mm	25 mm	Right-angle cut	AR/AR@532 nm + 750-850 nm	6646	Request
50 x 50 mm	30 mm	Right-angle cut	AR/AR@532 nm + 750-850 nm	6647	Request

Cr:LiSAF crystals



Cr³⁺:LiSAF gain medium possesses a broad emission band in the near infrared that allows a widely tunable laser operation and generation of ~10 fs light pulses via mode-locking technique. Cr:LiSAF crystals can be grown with a very low loss level (<0,2%/cm). It enables to construct high-Q-cavities, resulting in lasing thresholds as low as 2 mW and

slope efficiencies above 50%. Moreover, nonlinear refractive index of Cr:LiSAF is about four times lower than that of Ti:sapphire, which reduces parasitic nonlinearities in the ultrashort pulse generation and amplification applications.

Main features

- Broad absorption and emission bands
- Nonlinear refractive index is about four times lower than that of Ti:Sapphire
- Custom crystals available upon request

Application examples

- Femtosecond lasers and CPA laser systems

Standard specifications

CR:LiSAF CRYSTALS	
Orientation	a-cut
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<20 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 S-D
Surface flatness	<λ/10@632,8 nm
Coatings	AR[R<1%]@670 nm + AR[R<0,5%]@700-1100 nm on both faces
Laser induced damage threshold	>10 J/cm²@1064 nm, 10 ns
Mount	Unmounted

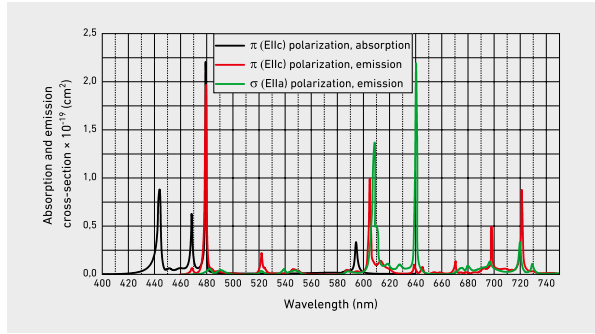
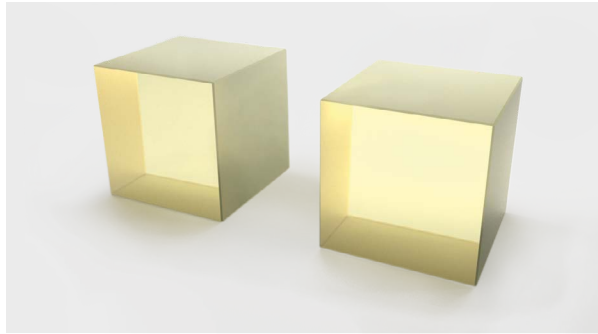
Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	670 nm
Absorption cross-section at peak	$5,5 \times 10^{20} \text{ cm}^2$
Absorption bandwidth at peak wavelength	-100 nm
Laser wavelength	830 [780-920] nm
Lifetime of ⁴ T ₂ energy level	67 μs
Emission cross-section	$5 \times 10^{20} \text{ cm}^2$
Refractive index	1,41
Crystal structure	trigonal
Density	3,45 kg/cm³
Mohs hardness	4
Thermal conductivity	4,6[a], 5,1[c] Wm ⁻¹ K ⁻¹
dn/dT	-4,2 × 10 ⁻⁶ K ⁻¹ [n _a], -4,6 × 10 ⁻⁶ K ⁻¹ [n _c]
Thermal expansion coefficient	22 × 10 ⁻⁶ [a] K ⁻¹ , 3,6 × 10 ⁻⁶ [c] K ⁻¹
Typical doping level	0,8-3 at. %

Standard products

FACE DIMENSIONS	LENGTH	END FACES	DOPING	COATINGS	SKU	PRICE
5 x 5 mm	12 mm	Brewster-angle cut	3%	Uncoated	7820	770 €
		Right-angle cut	3%	AR/AR@670 nm + 700-1100 nm	7819	930 €

Pr:YLF crystals



Very few laser materials have necessary properties for realization of lasing in the 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 , ${}^3\text{P}_0$ to ${}^3\text{F}_2$),

orange (607 nm , ${}^3\text{P}_0$ to ${}^3\text{H}_6$), green (523 nm , ${}^3\text{P}_0$ to ${}^3\text{H}_3$), and dark red (720 nm , ${}^3\text{P}_0$ ${}^3\text{F}_3$ + ${}^3\text{F}_4$) spectral regions. Pr^{3+} :YLF has been found to be a promising laser material for producing visible lasers directly and UV lasers through intracavity second-harmonic generation.

Main features

- High absorption and emission cross-sections ($\sim 10^{-19} \text{ cm}^2$)
- Good overlapping of the absorption band in the blue spectral region with the emission lines of the InGaN laser diodes and 2ω -OPSL
- Custom crystals available upon request

Application examples

- Diode-pumped solid-state lasers for precise and efficient processing of metals such as copper or gold, entertainment industry and science

Standard specifications

PR:YLF CRYSTALS	
Orientation	a-cut
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	$\pm 0,1 \text{ mm}$
Parallelism error	<10 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 S-D
Surface flatness	$< \lambda/8 @ 632,8 \text{ nm}$
Wavefront distortion	$\lambda/4 @ 632,8 \text{ nm}$
Coatings	AR(R<1%)@440-444 nm + AR(R<0,6%)@500-650 nm + AR(R<1%)@650-725 nm on both faces
Laser induced damage threshold	>5 J/cm ² @532 nm, 10 ns
Mount	Unmounted

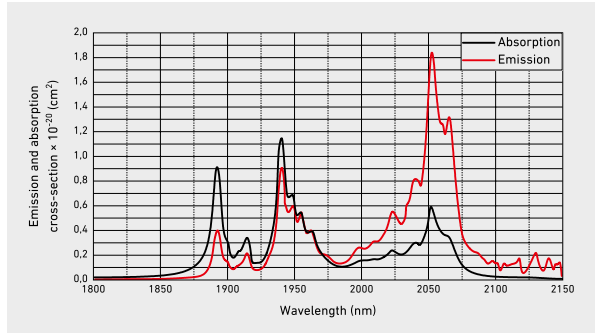
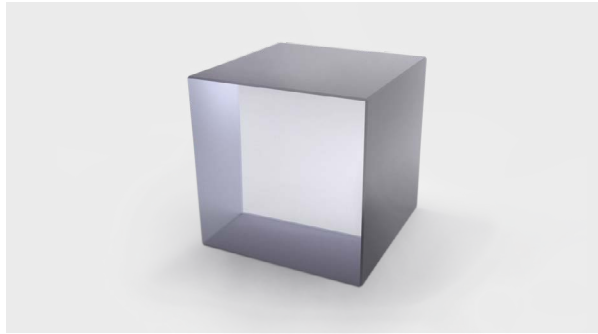
Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	444 nm
Absorption cross-section at peak	$8 \times 10^{-20} \text{ cm}^2$
Absorption bandwidth at peak wavelength	-5 nm
Laser wavelength	523 nm, 607 nm, 639 nm, 698 nm, 721 nm
Lifetime of ${}^3\text{P}_0$ energy level	50 μs
Emission cross-section at 640 nm	$20 \times 10^{-20} \text{ cm}^2$
Refractive index @1064 nm	$n_o = 1,448$, $n_e = 1,470$
Crystal structure	tetragonal
Density	3,95 g/cm ³
Mohs hardness	5
Thermal conductivity	6 Wm ⁻¹ K ⁻¹
dn/dT	$-5,2 \times 10^{-6} (c) \text{ K}^{-1}$, $-7,6 \times 10^{-6} (a) \text{ K}^{-1}$
Thermal expansion coefficient	$-16 \times 10^{-6} \text{ K}^{-1}$
Typical doping level	<1 at. %

Standard products

FACE DIMENSIONS	LENGTH	END FACES	DOPING	COATINGS	SKU	PRICE
2 x 2 mm	6 mm	Right-angle cut	0,5%	AR/AR@440-444 nm + 500-700 nm	7793	480 €
3 x 3 mm	6 mm	Right-angle cut	0,5%	AR/AR@440-444 nm + 500-700 nm	7794	540 €
ø5 mm	6 mm	Right-angle cut	0,5%	AR/AR@440-444 nm + 500-700 nm	7795	640 €

Ho:YLF crystals



Direct pumping of Ho:YLF crystals excludes losses of Tm³⁺ to Ho³⁺ energy transfer process. Ho³⁺:YLF crystal is characterized by a long

lifetime of ⁵I₇ energy level which results in an excellent performance in Q-switched operation.

Main features

- Long upper laser level lifetime
- High emission cross-section
- Naturally birefringent material
- Low value of dn/dT leading to a weak thermal lensing
- Custom crystals available upon request

Application examples

- Remote sensing and pollutant detection
- Industry
- Military

Standard specifications

HO:YLF CRYSTALS	
Orientation	a-cut
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<10 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 S-D
Surface flatness	<λ/10@632,8 nm
Coatings	AR(R<0,35%)@1900-2100 nm on both faces
LIDT	>10 J/cm ² @2060 nm, 10 ns
Mount	Unmounted

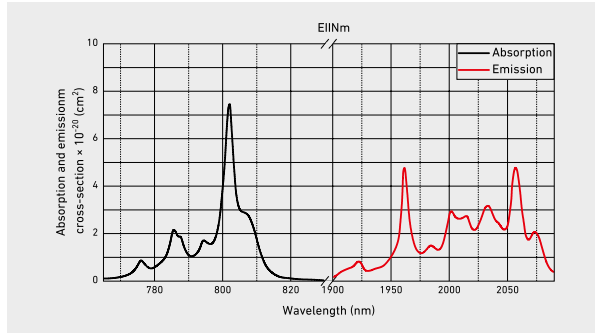
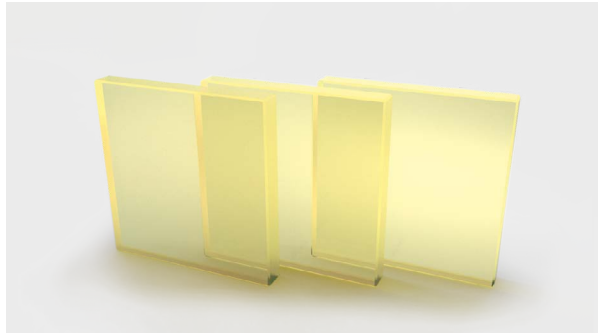
Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	1940 nm
Absorption cross-section at peak	1,2 × 10 ⁻²⁰ cm ²
Absorption bandwidth at peak wavelength	-18 nm
Laser wavelength	2060 nm
Lifetime of ⁵ I ₇ energy level	10 ms
Emission cross-section	1,8 × 10 ⁻²⁰ cm ²
Refractive index @1064 nm	n _o = 1,448, n _e = 1,470
Crystal structure	tetragonal
Density	3,95 g/cm ³
Mohs hardness	5
Thermal conductivity	6 Wm ⁻¹ K ⁻¹
dn/dT	-4,6 × 10 ⁻⁶ (c) K ⁻¹ , -6,6 × 10 ⁻⁶ (a) K ⁻¹
Thermal expansion coefficient	10,1 × 10 ⁻⁶ (c) K ⁻¹ , 14,3 × 10 ⁻⁶ (a) K ⁻¹
Typical doping level	0,5-1%

Standard products

FACE DIMENSIONS	LENGTH	END FACES	DOPING	COATINGS	SKU	PRICE
5 x 5 mm	2 mm	Brewster-angle cut	1%	Uncoated	7857	580 €
	2 mm	Right-angle cut	1%	AR/AR@1900-2100 nm	7858	700 €
ø8 mm	2 mm	Brewster-angle cut	1%	Uncoated	7859	580 €
	2 mm	Right-angle cut	1%	AR/AR@1900-2100 nm	7860	700 €

Tm, Ho:KYW crystals



Ho³⁺ ions are characterized by higher emission cross-sections and longer upper laser level lifetimes compared to their Tm³⁺ counterparts. These features are desirable for a low-threshold and efficient laser operation. Ho³⁺ does not possess any strong absorption lines that are well matched to the outputs of commercially

available laser diodes, therefore co-doping of Ho³⁺ with Tm³⁺ is chosen for an efficient operation across the 2 μm region through the energy transfer route from Tm³⁺ to Ho³⁺. Tm, Ho:KYW crystals are characterized by large and broad polarized absorption and emission bands, efficient energy transfer from Tm³⁺ to Ho³⁺.

Main features

- Large and broad polarized absorption and emission bands
- Efficient energy transfer from Tm³⁺ to Ho³⁺
- High dopant concentration with low concentration-quenching
- Custom crystals available upon request

Application examples

- 2 μm lasers for remote sensing (LIDAR technology), metrology and medical applications
- Pump source of mid-IR optical parametric oscillators (OPOs)

Standard specifications

TM, HO:KYW CRYSTALS	
Orientation	N _y -cut
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<10 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 S-D
Surface flatness	<λ/10 @ 632,8 nm
Coatings	AR[R<0,5%]@802 nm + AR[R<0,2%]@2000-2100 on both faces
LIDT	>10 J/cm ² @2060 nm, 10 ns
Mount	Unmounted

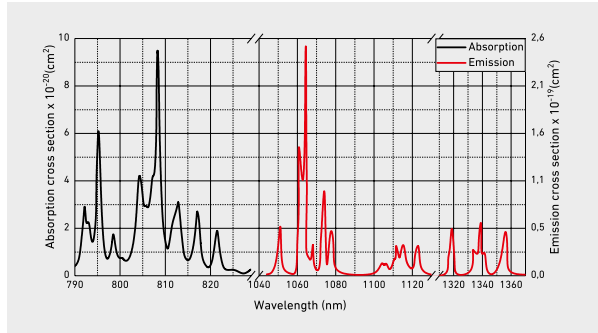
Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	802 nm
Absorption cross-section at peak	7,6 × 10 ⁻²⁰ cm ²
Absorption bandwidth at peak wavelength	~4 nm
Laser wavelength	2060 nm
Lifetime of ⁵ I ₇ energy level	1,8 ms
Emission cross-section @2056 nm	4,7 × 10 ⁻²⁰ cm ²
Refractive index @1040nm	n _y = 2,05, n _m = 2,01, n _z = 1,97
Crystal structure	monoclinic
Density	6,5 g/cm ³
Mohs hardness	4-5
Thermal conductivity	-3,3 Wm ⁻¹ K ⁻¹
dn/dT	dn _m /dT = -9,2 × 10 ⁻⁴ K ⁻¹
Thermal expansion coefficient	α _y = 1,83 × 10 ⁻⁴ K ⁻¹ , α _m = 10,29 × 10 ⁻⁴ K ⁻¹ , α _z = 15,94 × 10 ⁻⁴ K ⁻¹
Typical doping level	5 at.% [Tm] 0,5 at.% [Ho]

Standard products

FACE DIMENSIONS	LENGTH	END FACES	DOPING	COATINGS	SKU	PRICE
3 x 3 mm	2 mm	Brewster-angle cut	Tm 5%, Ho 0,5%	Uncoated	7856	460 €
		Right-angle cut	Tm 5%, Ho 0,5%	AR/AR@802 nm + 2002-2100 nm	7855	600 €

Nd:YAG crystals



Nd³⁺:YAG crystal is the most widely used solid-state laser material. These crystals are characterized by relatively small gain bandwidth, which allows achieving a high gain efficiency and a relatively low lasing threshold.

Nd:YAG crystals feature excellent thermal and mechanical properties. Nd:YAG of high optical quality and large diameter can be grown.

Main features

- Isotropic crystal (cubic symmetry)
- High thermal conductivity
- High optical quality and large diameter boules grown by Czochralski growth method
- Low lasing threshold and wide absorption band at near 808 nm that coincides with the emission of AlGaAs laser diodes
- Custom crystals available upon request

Application examples

- CW and pulsed operation at 1064 nm, 532 nm, 355 nm, 266 nm
- Material processing, welding, cutting
- Laser systems for medical applications

Standard specifications

ND:YAG CRYSTALS	
Orientation	[111]
Extinction ratio	>28 dB
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<20 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 S-D
Surface flatness	<λ/8@632,8 nm
Wavefront distortion	λ/4@632,8 nm
Coatings	AR(R<0,15%)@1064 nm on both sides or HT(T>95%)@808 nm + HR(R>99,5%)@1064 nm/AR(R<0,15%)@1064 nm
Laser induced damage threshold	>10 J/cm ² @1064 nm, 10 ns
Mount	Unmounted

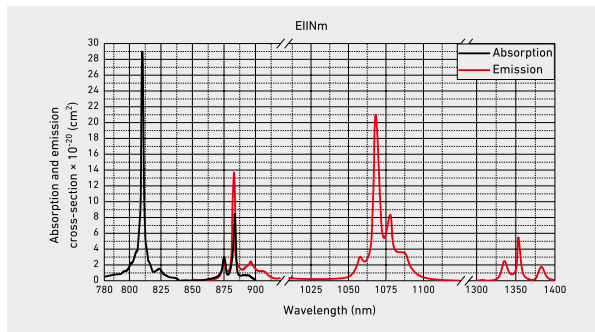
Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	808 nm
Absorption cross-section at peak	6,7 × 10 ⁻²⁰ cm ²
Absorption bandwidth at peak wavelength	2,5 nm
Laser wavelength	1064 nm
Lifetime of ⁴ F _{3/2} neodymium energy level	250 μs
Emission cross-section @1064	3 × 10 ⁻¹⁹ cm ²
Refractive index @1064 nm	1,82
Crystal structure	cubic
Density	4,56 g/cm ³
Mohs hardness	8,5
Thermal conductivity	-13 Wm ⁻¹ K ⁻¹
dn/dT	9,86 × 10 ⁻⁶ K ⁻¹
Thermal expansion coefficient	6,96 × 10 ⁻⁶ K ⁻¹
Typical doping level	0,6 - 1,3 at. %

Standard products

FACE DIMENSIONS	LENGTH	END FACES	DOPING	COATINGS	SKU	PRICE
ø3 mm	10 mm	Right-angle cut	0,8%	AR/AR@1064 nm	7106	260 €
	50 mm	Right-angle cut	0,8%	AR/AR@1064 nm	7071	360 €
	100 mm	Right-angle cut	0,8%	AR/AR@1064 nm	7072	490 €
ø5 mm	10 mm	Right-angle cut	0,8%	AR/AR@1064 nm	7076	280 €
	50 mm	Right-angle cut	0,8%	AR/AR@1064 nm	7077	390 €
	100 mm	Right-angle cut	0,8%	AR/AR@1064 nm	7078	590 €
ø3 mm	10 mm	Right-angle cut	1,1%	AR/AR@1064 nm	7073	260 €
	50 mm	Right-angle cut	1,1%	AR/AR@1064 nm	7074	360 €
	100 mm	Right-angle cut	1,1%	AR/AR@1064 nm	7075	490 €
ø5 mm	10 mm	Right-angle cut	1,1%	AR/AR@1064 nm	7079	280 €
	50 mm	Right-angle cut	1,1%	AR/AR@1064 nm	7080	390 €
	100 mm	Right-angle cut	1,1%	AR/AR@1064 nm	7081	590 €
3 x 3 mm	2 mm	Right-angle cut	1,1%	AR/AR@1064 nm	7082	220 €
	2 mm	Right-angle cut	1,1%	HT@808 nm + HR@1064 nm/AR@1064 nm	7085	240 €
	3 mm	Right-angle cut	1,1%	AR/AR@1064 nm	7083	220 €
	3 mm	Right-angle cut	1,1%	HT@808 nm + HR@1064 nm/AR@1064 nm	7086	240 €
	5 mm	Right-angle cut	1,1%	AR/AR@1064 nm	7084	220 €
	5 mm	Right-angle cut	1,1%	HT@808 nm + HR@1064 nm/AR@1064 nm	7087	240 €

Nd:KGW crystals



Nd:KGW crystal is a good choice for generation of picosecond laser pulses. These crystals are characterized by a lower stimulated emission cross-section compared to Nd:YAG crystals, therefore

provide a better performance in Q-switched operation. It is worth to mention, that it is possible to use the Nd:KGW laser crystal itself as a Raman converter.

Main features

- Suitable for generation of picosecond light pulses, well suited for diode-pumped lasers
- High storage density and low laser threshold
- Efficient Raman converter
- Custom crystals available upon request

Application examples

- Diode-pumped Q-switched lasers emitting in the "eye-safe" spectral range for laser rangefinders
- Raman converter

Standard specifications

ND:KGW CRYSTALS	
Orientation	b(N _z)-cut,
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<10 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 S-D
Surface flatness	<λ/10@632,8 nm
Coatings	AR(R<0,5%)808-811 nm + AR(R<0,15%)@1067 nm on both faces
Laser induced damage threshold	>10 J/cm ² @1067 nm, 10 ns
Mount	Unmounted

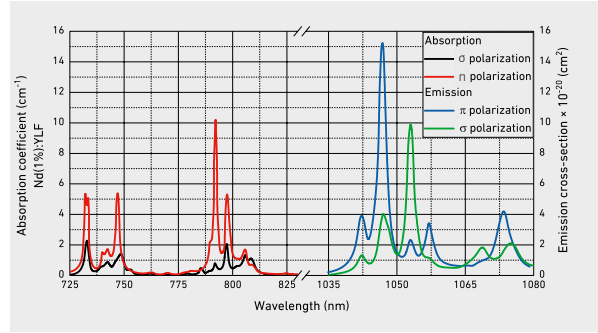
Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	811 nm
Absorption cross-section at peak	28 × 10 ²⁰ cm ²
Absorption bandwidth at peak wavelength	11 nm
Laser wavelength	1067 nm
Lifetime of ⁴ F _{3/2} neodymium energy level	130 μs
Emission cross-section @1067 nm	21 × 10 ²⁰ cm ²
Refractive index @1067nm	n _o = 2,033, n _p = 1,937, n _m = 1,986
Crystal structure	Monoclinic
Density	7,25 g/cm ³
Mohs hardness	4-5
Thermal conductivity	-3 Wm ⁻¹ K ⁻¹
dn/dT	dn _o /dT = -15,7×10 ⁻⁶ K ⁻¹ dn _m /dT = -11,8×10 ⁻⁶ K ⁻¹ dn _p /dT = -17,3×10 ⁻⁶ K ⁻¹
Thermal expansion coefficient	α _p = 1,60 × 10 ⁻⁶ K ⁻¹ , α _m = 4 × 10 ⁻⁶ K ⁻¹ , α _o = 8,5 × 10 ⁻⁶ K ⁻¹
Typical doping level	2-10 at. %

Standard products

FACE DIMENSIONS	LENGTH	END FACES	DOPING	COATINGS	SKU	PRICE
3 x 3 mm	5 mm	Right-angle cut	3%	AR/AR@808-811 nm + 1067 nm	7798	480 €
ø3 mm	60 mm	Right-angle cut	3%	AR/AR@1067 nm	7800	780 €
3 x 3 mm	3 mm	Right-angle cut	5%	AR/AR@808-811 nm + 1067 nm	7796	480 €
3 x 3 mm	5 mm	Right-angle cut	5%	AR/AR@808-811 nm + 1067 nm	7797	480 €
ø3 mm	5 mm	Brewster-angle cut	5%	Uncoated	7799	420 €

Nd:YLF crystals



Nd³⁺:YLF crystal is characterized by a long lifetime of ⁴F_{3/2} neodymium energy level. Compared to Nd:YAG, the lower thermal conductivity and a weak negative dn/dT lead to lower thermal distortions and allow to

achieve a better output beam quality. Another distinctive feature is the high UV transparency, which is favorable for pumping with xenon flashlamps.

Main features

- Long lifetime of ⁴F_{3/2} neodymium energy level
- Considerably softer and more brittle than Nd:YAG is
- Nd:YLF (a-cut) crystals that are used inside a laser optical resonator are self-polarizing
- Custom crystals available upon request

Application examples

- CW and pulsed operation at 1047nm and 1053 nm
- Material processing, welding, cutting

Standard specifications

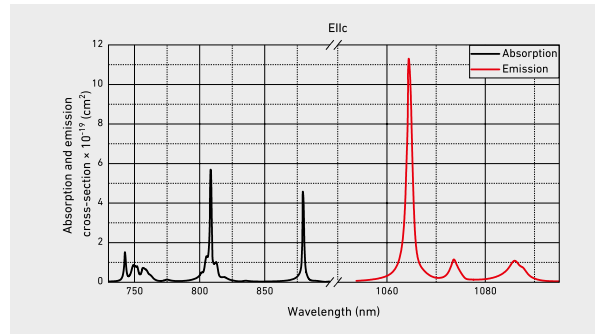
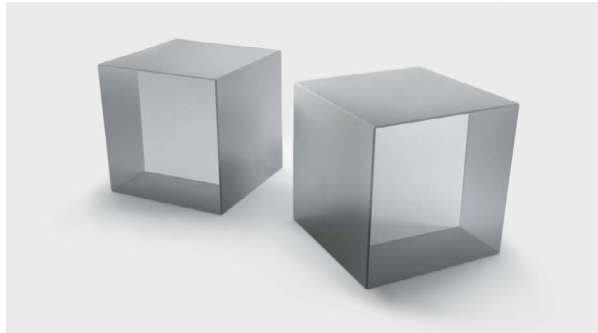
ND:YLF CRYSTALS	
Orientation	a-cut, c-cut
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<10 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 S-D
Surface flatness	<λ/8@632,8 nm
Wavefront distortion	λ/4@632,8 nm
Coatings	AR(R<0,5%)@790-810 nm + AR(R<0,2%)@1047-1053 nm on both faces
Laser induced damage threshold	>10 J/cm²@1064 nm, 10 ns
Mount	Unmounted

Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	792 nm
Absorption coefficient at peak	10 cm ⁻¹
Absorption bandwidth at peak wavelength	-5 nm
Laser wavelength	1047, 1053 nm
Lifetime of ⁴ F _{3/2} neodymium energy level	485 μs
Emission cross-section	15 × 10 ⁻²⁰ [E C] cm ² @1047 nm 10 × 10 ⁻²⁰ [E⊥C] cm ² @1053 nm
Refractive index @1064 nm	n _e = 1,448, n _o = 1,470
Crystal structure	tetragonal
Density	3,95 g/cm ³
Mohs hardness	5
Thermal conductivity	6 Wm ⁻¹ K ⁻¹
dn/dT	-4,6 × 10 ⁻⁶ [c] K ⁻¹ , -6,6 × 10 ⁻⁶ [a] K ⁻¹
Thermal expansion coefficient	8 × 10 ⁻⁶ [c] K ⁻¹ , 13 × 10 ⁻⁶ [a] K ⁻¹
Typical doping level	1-2 at. %

Standard products

FACE DIMENSIONS	LENGTH	END FACES	ORIENTATION	DOPING	COATINGS	SKU	PRICE
ø5 mm	10 mm	Right-angle cut	a-cut	1%	AR/AR@790-810 nm + 1047-1053 nm	7097	480 €
	20 mm	Right-angle cut	a-cut	1%	AR/AR@790-810 nm + 1047-1053 nm	7098	580 €
	50 mm	Right-angle cut	a-cut	1%	AR/AR@790-810 nm + 1047-1053 nm	7099	Request
	100 mm	Right-angle cut	a-cut	1%	AR/AR@790-810 nm + 1047-1053 nm	7100	Request
	10 mm	Right-angle cut	c-cut	1%	AR/AR@790-810 nm + 1047-1053 nm	7101	480 €
	20 mm	Right-angle cut	c-cut	1%	AR/AR@790-810 nm + 1047-1053 nm	7102	640 €
	100 mm	Right-angle cut	c-cut	1%	AR/AR@790-810 nm + 1047-1053 nm	7104	Request
	50 mm	Right-angle cut	c-cut	1%	AR/AR@790-810 nm + 1047-1053 nm	7103	Request

Nd:YVO₄ crystals

Compared to Nd³⁺:YAG crystals, the Nd³⁺:YVO₄ crystal has much higher absorption and emission cross-sections, a broader gain bandwidth and wavelength range for pumping, a shorter upper-state lifetime, a higher refractive index, thus it is characterized by a lower thermal conductivity. Nd:YVO₄ crystals are well suited for passively mode-locked lasers with high pulse repetition rates. A drawback of

Nd:YVO₄ lasers is that it is impossible to achieve pulse energies as high as it is achievable with Nd:YAG lasers at Q-switched operation, due to the lower upper-state lifetime and higher gain efficiency. In conclusion, Nd:YVO₄ is better suited as an active medium of high pulse repetition rate Q-switched lasers and CW lasers with a lower lasing threshold.

Main features

- High absorption and gain cross-sections
- Strongly polarization dependent absorption and emission spectra (n-polarization is preferable)
- Shorter (compared with Nd:YAG) upper-state lifetime
- High optical quality and large diameter boules obtained by Czochralski growth method
- Custom crystals available upon request

Application examples

- High repetition rate Q-switched lasers for marking and engraving
- Mode-locked lasers for spectroscopy and research

Standard specifications

ND:YVO ₄ CRYSTALS	
Orientation	a-cut
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<10 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 S-D
Surface flatness	<λ/8@632,8 nm
Coatings	AR(R<0,5%)@808 nm + AR(R<0,15%)@1064 nm and HT(T>95%)@808 nm + HR(R>99,8%)@1064 nm/AR(R<0,2%)@1064 nm
Laser induced damage threshold	>10 J/cm ² @1064nm, 10 ns
Mount	Unmounted

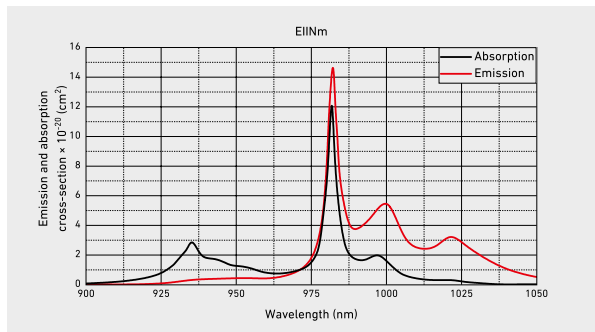
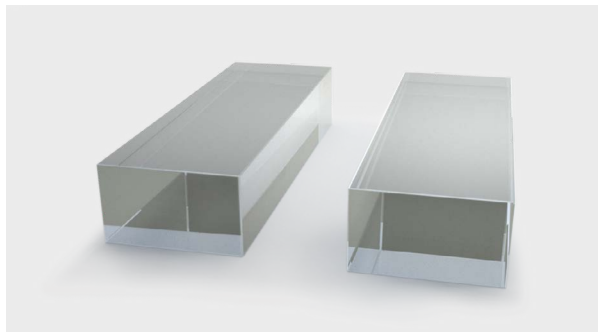
Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	808 nm
Absorption cross-section at peak	5,8 × 10 ⁻¹⁹ cm ²
Absorption bandwidth at peak wavelength	16 nm
Laser wavelength	1064 nm
Lifetime of ⁴ F _{3/2} neodymium energy level	90 μs
Emission cross-section @1064 nm	11,4 × 10 ⁻¹⁹ cm ²
Refractive index @1064 nm	n _o = 1,96, n _e = 2,17
Crystal structure	Tetragonal
Density	4,22 g/cm ³
Mohs hardness	5
Thermal conductivity	-5 Wm ⁻¹ K ⁻¹
dn/dT	3,0 × 10 ⁻⁴ (c) K ⁻¹ , 8,5 × 10 ⁻⁶ (a) K ⁻¹
Thermal expansion coefficient	11 × 10 ⁻⁶ (c) K ⁻¹ , 4,4 × 10 ⁻⁶ (a) K ⁻¹
Typical doping level	0,1-4 at. %

Standard products

FACE DIMENSIONS	LENGTH	END FACES	DOPING	COATINGS	SKU	PRICE
3 x 3 mm	5 mm	Right-angle cut	1%	AR/AR@808 nm + 1064 nm	7105	280 €
		Right-angle cut	1%	HT@808 nm + HR@1064 nm/AR@1064 nm	7092	350 €
	2 mm	Right-angle cut	2%	AR/AR@808 nm + 1064 nm	7089	280 €
		Right-angle cut	2%	HT@808 nm + HR@1064 nm/AR@1064 nm	7094	350 €
	3 mm	Right-angle cut	2%	AR/AR@808 nm + 1064 nm	7088	280 €
		Right-angle cut	2%	HT@808 nm + HR@1064 nm/AR@1064 nm	7093	350 €
	0,5 mm	Right-angle cut	3%	AR/AR@808 nm + 1064 nm	7091	280 €
		Right-angle cut	3%	HT@808 nm + HR@1064 nm/AR@1064 nm	7096	350 €
	1 mm	Right-angle cut	3%	AR/AR@808 nm + 1064 nm	7090	280 €
		Right-angle cut	3%	HT@808 nm + HR@1064 nm/AR@1064 nm	7095	350 €

Yb:KGW crystals



Yb³⁺:KGW crystals possess a large gain bandwidth that enables to obtain <100 fs pulse duration in mode-locked regime of operation. Compared with other ytterbium-doped gain media with a similarly large gain bandwidth, ytterbium-doped tungstate has fairly high emission cross-sections. Ytterbium doping concentration in Yb:KGW

crystals can be up to 5 at. % without a significant quenching. Thermal conductivity of common double tungstates is in the range of 3–4 Wm⁻¹K⁻¹. Yb:KGW crystals exhibit a small quantum defect and it is possible to operate with a quantum defect well below ~4-5%.

Main features

- Large gain bandwidth
- High emission cross-sections
- Small quantum defect
- High doping level
- High thermal conductivity
- Custom crystals available upon request

Application examples

- Femtosecond lasers and regenerative amplifiers
- CW and passively mode-locked thin-disk lasers

Standard specifications

YB:KGW CRYSTALS	
Orientation	Ng-cut; Np(lb)-cut and other orientation available
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<10 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 S-D
Surface flatness	<λ/10@632,8 nm
Coatings	AR(R<0,5%)@970-1070 nm
Laser induced damage threshold	>10 J/cm ² @1040 nm, 10 ns
Mount	Unmounted

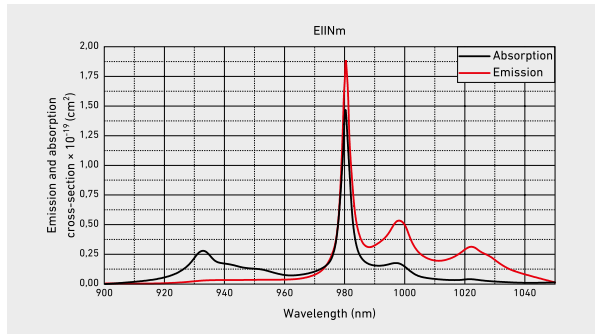
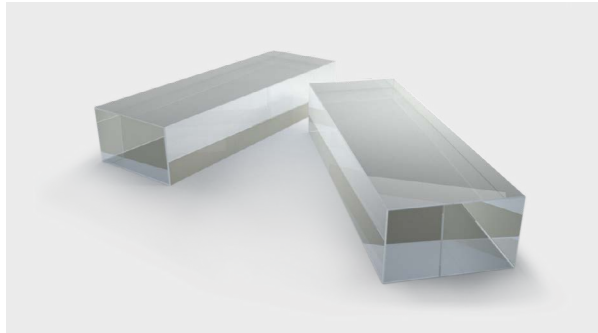
Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	980 nm
Absorption cross-section at peak wavelength	$12 \times 10^{-20} \text{ cm}^2$ [E N _m]
Absorption bandwidth at peak wavelength	3,7 nm
Laser wavelength	1025 [1020-1060] nm
Lifetime of ² F _{5/2} ytterbium energy level	240 μs
Emission cross-section at 1030 nm	$3 \times 10^{-20} \text{ cm}^2$ [E N _m]
Refractive index at 1064 nm	n _o = 2,037 n _e = 1,986 n _m = 2,033
Crystal structure	Monoclinic
Density	7,25 g/cm ³
Mohs hardness	4-5
Thermal conductivity	K _x = 2,6 Wm ⁻¹ K ⁻¹ K _y = 3,8 Wm ⁻¹ K ⁻¹ K _z = 3,4 Wm ⁻¹ K ⁻¹
dn/dT	dn _o /dT = -15,7×10 ⁻⁶ K ⁻¹ dn _m /dT = -11,8×10 ⁻⁶ K ⁻¹ dn _e /dT = -17,3×10 ⁻⁶ K ⁻¹
Thermal expansion coefficient	α _o = 1,7 × 10 ⁻⁶ K ⁻¹ α _m = 11,01 × 10 ⁻⁶ K ⁻¹ α _e = 17,37 × 10 ⁻⁶ K ⁻¹
Typical doping level	1-5 at. %

Standard products

FACE DIMENSIONS	LENGTH	END FACES	DOPING	COATINGS	SKU	PRICE
3 x 3 mm	10 mm	Brewster-angle cut	1%	Uncoated	7051	540 €
	10 mm	Right-angle cut	1%	AR/AR@970-1070 nm	7049	590 €
5 x 5 mm	10 mm	Brewster-angle cut	1%	Uncoated	7052	540 €
	10 mm	Right-angle cut	1%	AR/AR@970-1070 nm	7050	590 €
3 x 3 mm	5 mm	Brewster-angle cut	2%	Uncoated	7055	540 €
	5 mm	Right-angle cut	2%	AR/AR@970-1070 nm	7053	590 €
5 x 5 mm	5 mm	Brewster-angle cut	2%	Uncoated	7056	540 €
	5 mm	Right-angle cut	2%	AR/AR@970-1070 nm	7054	590 €
3 x 3 mm	3 mm	Brewster-angle cut	3%	Uncoated	7059	540 €
	3 mm	Right-angle cut	3%	AR/AR@970-1070 nm	7057	590 €
5 x 5 mm	3 mm	Brewster-angle cut	3%	Uncoated	7060	540 €
	3 mm	Right-angle cut	3%	AR/AR@970-1070 nm	7058	590 €
3 x 3 mm	2 mm	Brewster-angle cut	5%	Uncoated	7063	540 €
	2 mm	Right-angle cut	5%	AR/AR@970-1070 nm	7061	590 €
5 x 5 mm	2 mm	Brewster-angle cut	5%	Uncoated	7064	540 €
	2 mm	Right-angle cut	5%	AR/AR@970-1070 nm	7062	590 €

Yb:KYW crystals



Yb³⁺:KYW crystals possess a large gain bandwidth that enables to obtain <100 fs pulse duration in mode-locked regime of operation. Compared with other ytterbium-doped gain media with a similarly large gain bandwidth, ytterbium-doped tungstates have fairly high

emission cross-sections. Ytterbium doping concentration in Yb:KYW crystals can be very high without a significant quenching. Thermal conductivity of common double tungstates is in the range of 3–4 Wm⁻¹K⁻¹. Yb:KYW crystals also feature a small quantum defect.

Main features

- Large gain bandwidth
- High emission cross-sections
- Small quantum defect
- High doping level
- High enough thermal conductivity
- Custom crystals available upon request

Application examples

- Femtosecond lasers and regenerative amplifiers
- CW and passively mode-locked thin-disk lasers

Standard specifications

YB:KYW CRYSTALS	
Orientation	Ng-cut; Np(b)-cut and other orientation available
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<10 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 S-D
Surface flatness	<λ/10@632,8 nm
Coatings	AR(R<0,5%)@970-1070 nm
Laser induced damage threshold	>10 J/cm ² @1040 nm, 10 ns
Mount	Uncoated

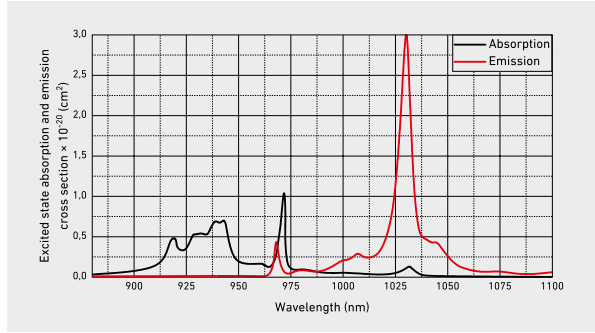
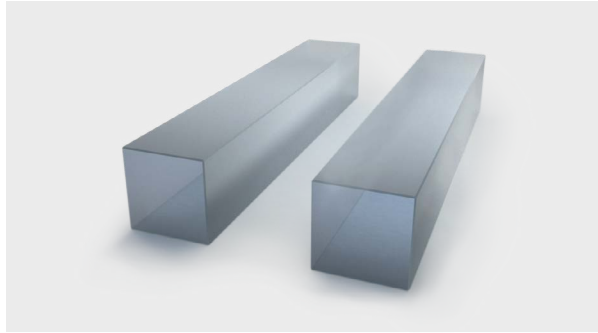
Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	980 nm
Absorption cross-section at peak wavelength	14 × 10 ⁻²⁰ cm ² [E II N _m]
Absorption bandwidth at peak wavelength	-3 nm
Laser wavelength	1020 [1020-1050] nm
Lifetime of ² F _{5/2} ytterbium energy level	230 μs
Emission cross-section at 1030 nm	2,5 × 10 ⁻²⁰ cm ² [E II N _m]
Refractive index at 1064 nm	n _y = 2,037 n _p = 1,986 n _m = 2,033
Crystal structure	Monoclinic
Density	6,61 g/cm ³
Mohs hardness	4-5
Thermal conductivity	-3,3 Wm-1K ⁻¹
dn/dT	dn _y /dT = -13,08 × 10 ⁻⁶ K ⁻¹ dn _m /dT = -7,61 × 10 ⁻⁶ K ⁻¹ dn _p /dT = -11,83 × 10 ⁻⁶ K ⁻¹
Thermal expansion coefficient	α _p = 1,9 × 10 ⁻⁶ K ⁻¹ α _m = 10,3 × 10 ⁻⁶ K ⁻¹ α _y = 16,5 × 10 ⁻⁶ K ⁻¹
Typical doping level	1-100 at. %

Standard products

FACE DIMENSIONS	LENGTH	END FACES	DOPING	COATINGS	SKU	PRICE
3 x 3 mm	5 mm	Brewster-angle cut	2%	Uncoated	7037	540 €
	5 mm	Right-angle cut	2%	AR/AR@970-1070 nm	7035	590 €
5 x 5 mm	5 mm	Brewster-angle cut	2%	Uncoated	7038	540 €
	5 mm	Right-angle cut	2%	AR/AR@970-1070 nm	7036	590 €
3 x 3 mm	2 mm	Brewster-angle cut	5%	Uncoated	7039	540 €
	2 mm	Right-angle cut	5%	AR/AR@970-1070 nm	7041	590 €
5 x 5 mm	2 mm	Brewster-angle cut	5%	Uncoated	7042	540 €
	2 mm	Right-angle cut	5%	AR/AR@970-1070 nm	7040	590 €
3 x 3 mm	1 mm	Brewster-angle cut	10%	Uncoated	7045	540 €
	1 mm	Right-angle cut	10%	AR/AR@970-1070 nm	7043	590 €
5 x 5 mm	1 mm	Brewster-angle cut	10%	Uncoated	7046	540 €
	1 mm	Right-angle cut	10%	AR/AR@970-1070 nm	7044	590 €

Yb:YAG crystals



Yb³⁺:YAG crystals feature a 950 μs lifetime of the ²F_{5/2} ytterbium energy level and a quantum defect of only ~9%. Yb:YAG crystals also possess a broad pump band at near 940 nm that is more than 10 times broader than the 808 nm pump line of Nd:YAG crystals. It makes Yb:YAG

systems less sensitive to thermal shift of pump diodes wavelength. Yb:YAG lasers emit typically at either 1030 nm (strongest line) or 1050 nm. It is often used in powerful and efficient thin-disk lasers.

Main features

- Simple electronic structure excludes excited-state absorption and also a variety of detrimental quenching processes
- Broad absorption band at 940 nm
- Long lifetime of the ²F_{5/2} ytterbium energy level
- Low quantum defect
- Custom crystals available upon request

Application examples

- Material processing, micromachining, welding, cutting
- Efficient high power thin-disk lasers

Standard specifications

YB:YAG CRYSTALS	
Orientation	[111]
Extinction ratio	>28 dB
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<20 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,15 mm at 45°
Surface quality	10-5 S-D
Surface flatness	<λ/10@632,8 nm
Wavefront distortion	λ/4@632,8 nm
Coatings	AR[R<0,5%]@940 nm + AR[R<0,2%]@1030 nm on both faces
Laser induced damage threshold	>10 J/cm ² @1030 nm, 10 ns
Mount	Unmounted

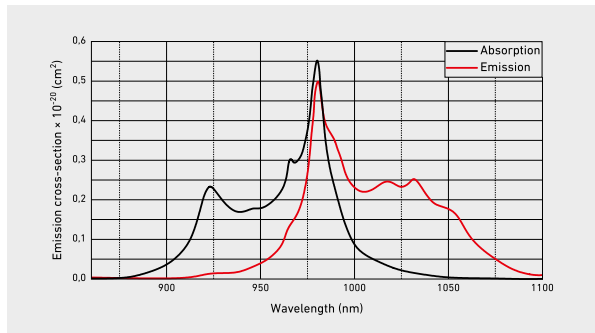
Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	942 nm
Absorption cross-section at peak wavelength	7,7 × 10 ⁻²¹ cm ²
Absorption bandwidth at peak wavelength	18 nm
Laser wavelength	1030 nm
Lifetime of ² F _{5/2} ytterbium energy level	950 μs
Emission cross-section @1030 nm	2,1 × 10 ⁻²⁰ cm ²
Refractive index @632,8 nm	1,83
Crystal structure	Cubic
Density	4,56 g/cm ³
Mohs hardness	8,5
Thermal conductivity	-13 Wm ⁻¹ K ⁻¹
dn/dT	7,8 × 10 ⁻⁶ K ⁻¹
Thermal expansion coefficient	6,2 × 10 ⁻⁶ K ⁻¹
Typical doping level	1-20 at. %

Standard products

FACE DIMENSIONS	LENGTH	END FACES	DOPING	COATINGS	SKU	PRICE
5 x 5 mm	10 mm	Brewster-angle cut	1%	Uncoated	6664	500 €
		Right-angle cut	1%	AR/AR@940 nm + 1030 nm	6661	540 €
	2 mm	Brewster-angle cut	5%	Uncoated	6663	500 €
		Right-angle cut	5%	AR/AR@940 nm + 1030 nm	6660	540 €
	1 mm	Brewster-angle cut	10%	Uncoated	6662	500 €
		Right-angle cut	10%	AR/AR@940 nm + 1030 nm	6659	540 €

Yb:CaF₂ crystals



Yb³⁺:CaF₂ are among most studied and promising crystals for the development of short-pulse, high-energy, high-power diode-pumped solid-state lasers. There are several reasons that explain this trend. Firstly, calcium fluoride is a simple cubic crystal whose crystallographic properties are fairly well known.

Moreover, this crystal can be grown of large dimension and optical quality. The simple structure of this crystal contributes to its good thermal properties. Finally, Yb-doped calcium fluorides feature very broad and smooth emission bands, which is exceptional for cubic crystals.

Main features

- Isotropic crystal (cubic symmetry)
- Low quantum defect
- Long lifetime of the ²F_{5/2} ytterbium energy level
- Wide optical transmission
- Low dispersion behavior
- Limited nonlinear effects under intense laser irradiation
- Custom crystals available upon request

Application examples

- Diode-pumped femtosecond solid-state lasers aiming at the generation of high-energy pulses
- Ultrashort pulses with high average power

Standard specifications

YB:CAF ₂ CRYSTALS	
Orientation	[111]
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<10 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,15 mm at 45°
Surface quality	10-5 S-D
Surface flatness	<λ/10@632,8 nm
Coatings	AR(R<0,5%)@980 nm + AR(R< 0,35%)@1040-1070 nm
Laser induced damage threshold	>10 J/cm ² @1040 nm, 10 ns
Mount	Unmounted

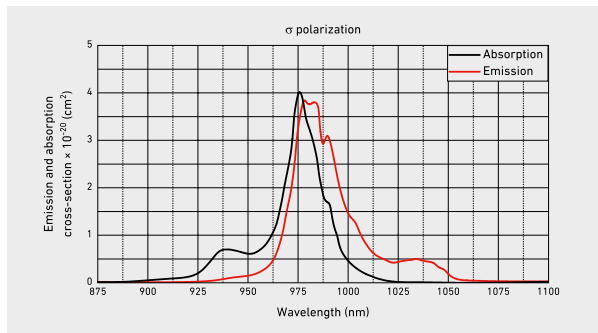
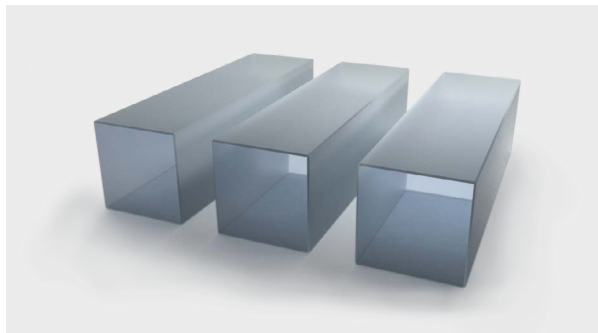
Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	976 nm
Absorption cross-section at peak	0,54 × 10 ⁻²⁰ cm ²
Laser wavelength	1020-1060 nm
Lifetime of ² F _{5/2} energy level	2,4 ms
Emission cross-section @1053 nm	0,16 × 10 ⁻²⁰ cm ²
Refractive index @1040nm	1,43
Crystal structure	cubic
Density	3,18 g/cm ³
Mohs hardness	4
Thermal conductivity	5,4 Wm ⁻¹ K ⁻¹
dn/dT	-11,3 × 10 ⁻⁶ K ⁻¹
Thermal expansion coefficient	18,9 × 10 ⁻⁶ K ⁻¹
Typical doping level	1-5 at. %

Standard products

FACE DIMENSIONS	LENGTH	END FACES	DOPING	COATINGS	SKU	PRICE
ø3 mm	10 mm	Brewster-angle cut	1%	Uncoated	7032	540 €
		Right-angle cut	1%	AR/AR@980 nm + 1040-1070 nm	7029	590 €
	5 mm	Brewster-angle cut	3%	Uncoated	7031	540 €
		Right-angle cut	3%	AR/AR@980 nm + 1040-1070 nm	7028	590 €
	3 mm	Brewster-angle cut	5%	Uncoated	7030	540 €
		Right-angle cut	5%	AR/AR@980 nm + 1040-1070 nm	7027	590 €

Yb:YAB crystals



Yb³⁺:YAB is one of the few representatives with multifunctional properties: as a negative uniaxial crystal, it also possesses nonlinear optical properties, permitting a direct conversion of the infrared radiation to the visible through second order nonlinear processes.

High concentrations of Yb³⁺ ions can be included in the YAB crystal matrix with little concentration quenching. Yb:YAB crystals feature good mechanical strength, good thermal conductivity, and stable chemical characteristics.

Main features

- Self-doubling laser crystal
- High thermal conductivity
- Wide absorption bandwidth near 976 nm
- High absorption and emission cross-sections
- Low quantum defect
- Custom crystals available upon request

Application examples

- High power CW lasers
- Mode-locked femtosecond lasers
- CW and mode-locked self-doubling lasers

Standard specifications

YB:YAB CRYSTALS	
Orientation	c-cut, a-cut available
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<10 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 S-D
Surface flatness	<λ/10@632,8 nm
Coatings	Antireflective [AR] coatings on both faces
Laser induced damage threshold	>10 J/cm ² @1030 nm, 10 ns (for AR/AR@960-1060 nm coatings)
Mount	Unmounted

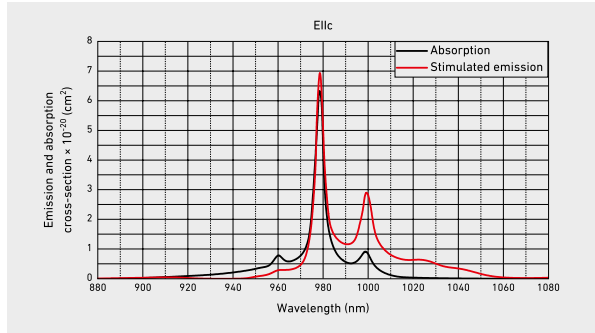
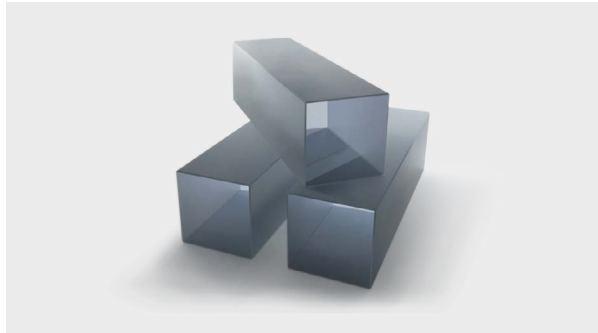
Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	976 nm
Absorption cross-section at peak	3,8 × 10 ⁻²⁰ cm ²
Absorption bandwidth at peak wavelength	20 nm
Laser wavelength	1040 nm
Lifetime of ² F _{5/2} energy level	680 μs
Emission cross-section @1040 nm	0,5 × 10 ⁻²⁰ cm ²
Refractive index @632.8 nm	n _o =1,7757, n _e =1,7015
Crystal structure	Trigonal
Density	3,84 g/cm ³
Mohs hardness	7,5
Thermal conductivity	-6 Wm ⁻¹ K ⁻¹
dn/dT	1,4 × 10 ⁻⁶ [IIa] K ⁻¹ , 4,8 × 10 ⁻⁴ [IIc] K ⁻¹
Thermal expansion coefficient	2 × 10 ⁻⁴ [IIa] K ⁻¹ , 9,5 × 10 ⁻⁴ [IIc] K ⁻¹
Typical doping level	5-8 wt.%

Standard products

FACE DIMENSIONS	LENGTH	END FACES	ORIENTATION	DOPING	COATINGS	SKU	PRICE
3 x 3 mm	2 mm	Right-angle cut	c-cut	10%	AR/AR@960-1060 nm	12826	590 €
		Brewster-angle cut	c-cut	10%	Uncoated	12827	540 €
		Right-angle cut	θ = 31°, φ = 0°	10%	AR/AR@520+976+1040 nm	12828	Request

Yb:YAP crystals



Yttrium aluminate doped with Yb³⁺, (Yb³⁺:YAP) is a biaxial orthorhombic crystal. YAP crystal hardness and thermal conductivity are similar to YAG but exhibits a highly anisotropic thermal expansion coefficient and is birefringent. Emission wavelengths are polarized, while

emission and absorption cross-sections are strongly dependent upon the crystallographic orientation. The absorption cross-sections of the Yb:YAP crystal is higher than that of the Yb:YAG crystal.

Main features

- Biaxial orthorhombic crystal
- High absorption cross-section dependent upon the crystallographic orientation
- High thermal conductivity
- Low quantum defect
- Custom crystals available upon request

Application examples

- Femtosecond lasers and regenerative amplifiers
- CW and passively mode-locked thin-disk lasers

Standard specifications

YB:YAP CRYSTALS	
Orientation	a-cut
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<10 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 S-D
Surface flatness	<λ/10@632,8 nm
Coatings	AR(R<0,25%)@978 nm + AR(R<0,15%)@1020-1070 nm on both sides
Laser induced damage threshold	>10 J/cm ² @1030 nm, 10 ns
Mount	Unmounted

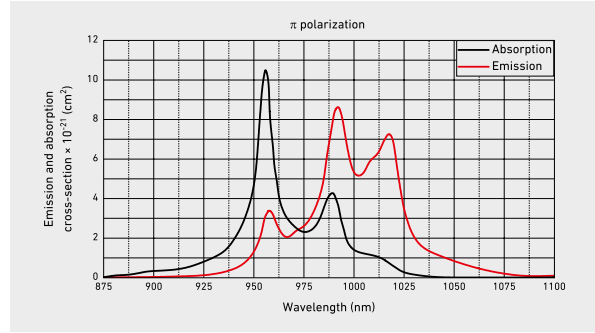
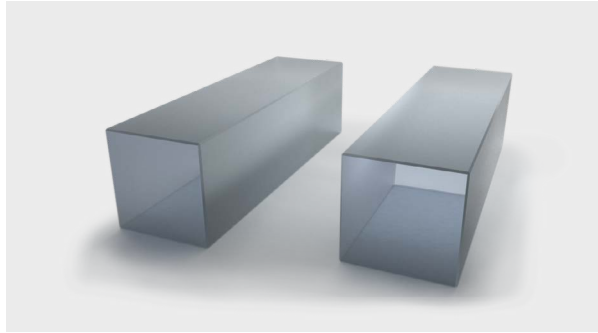
Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	978 nm
Absorption cross-section at peak	6,6 × 10 ⁻²⁰ cm ²
Absorption bandwidth at peak wavelength	4 nm
Laser wavelength	1040 nm
Lifetime of ² F _{5/2} energy level	500 μs
Emission cross-section @1040 nm	0,5 × 10 ⁻²⁰ cm ²
Refractive index @632.8 nm	1,96 (IIa), 1,94 (IIb), 1,97 (IIc)
Crystal structure	orthorhombic
Density	5,35 g/cm ³
Mohs hardness	8,5
Thermal conductivity	11,7 (IIa), 10,0 (IIb), 13,3 (IIc) Wm ⁻¹ K ⁻¹

Standard products

FACE DIMENSIONS	LENGTH	END FACES	DOPING	COATINGS	SKU	PRICE
3 x 3 mm	5 mm	Brewster-angle cut	1%	Uncoated	7826	Request
		Right-angle cut	1%	AR/AR@978 nm + 1020-1070 nm	7825	Request

Yb:YLF crystals



Yb³⁺:YLF features a wide emission cross-section, with peak value at the lasing wavelength comparable to that found in Yb³⁺:Sr₃Y(BO₃)₃ and

Yb³⁺:Ca₄GdO(BO₃)₃ laser crystals. Also, the YLF crystal is favorable when high ytterbium ion dopant concentrations are desired.

Main features

- Simple electronic structure excludes excited-state absorption and also a variety of detrimental quenching processes
- Broad and smooth emission spectrum
- Wide tuning range
- Absorption spectra are well matched with the emission wavelength of InGaAs laser diodes
- Low quantum defect
- Custom crystals available upon request

Application examples

- Diode-pumped mode-locked lasers
- Thin-disk lasers

Standard specifications

YB:YLF CRYSTALS	
Orientation	a-cut
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<10 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 S-D
Surface flatness	<λ/10@632,8 nm
Coatings	AR[R<0,5%]@960 nm + AR[R<0,2%] @1000-1060 nm on both faces
Laser induced damage threshold	>10 J/cm²@1030 nm, 10 ns
Mount	Unmounted

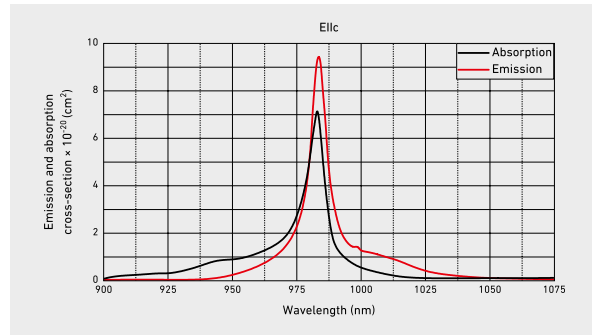
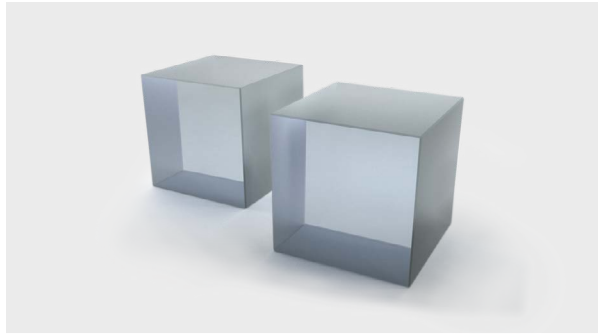
Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	960 nm
Absorption cross-section at peak	10,5 × 10 ⁻²¹ cm ²
Absorption bandwidth at peak wavelength	-10 nm
Laser wavelength	1017 nm
Lifetime of ² F _{5/2} energy level	2,1 ms
Emission cross-section @1053 nm	4,1 × 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 × 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
Typical doping level	5-20 at. %

Standard products

FACE DIMENSIONS	LENGTH	END FACES	DOPING	COATINGS	SKU	PRICE
3 x 3 mm	8 mm	Right-angle cut	5%	AR/AR@960 nm + 1000-1060 nm	7828	590 €
3 x 3 mm	8 mm	Brewster-angle cut	5%	Uncoated	7829	540 €
ø8 mm	8 mm	Right-angle cut	5%	AR/AR@960 nm + 1000-1060 nm	7830	680 €
3 x 3 mm	4 mm	Brewster-angle cut	10%	Uncoated	7832	540 €
3 x 3 mm	4 mm	Right-angle cut	10%	AR/AR@960 nm + 1000-1060 nm	7831	590 €
ø8 mm	4 mm	Right-angle cut	10%	AR/AR@960 nm + 1000-1060 nm	7833	680 €
3 x 3 mm	2 mm	Brewster-angle cut	20%	Uncoated	7835	540 €
3 x 3 mm	2 mm	Right-angle cut	20%	AR/AR@960 nm + 1000-1060 nm	7834	590 €
ø8 mm	2 mm	Right-angle cut	20%	AR/AR@960 nm + 1000-1060 nm	7836	680 €

Yb:YVO₄ crystals



Yb³⁺:YVO₄ crystal has a broad and smooth emission spectrum that allows wide wavelength tuning ranges and generating ultrashort pulses in mode-locked lasers. Due to good thermal conductivity

Yb:YVO₄ crystals can be used as an active medium in high-power thin-disk lasers.

Main features

- The simple electronic structure excludes excited-state absorption and also a variety of detrimental quenching processes
- Broad and smooth emission spectrum
- Low quantum defect
- Custom crystals available upon request

Application examples

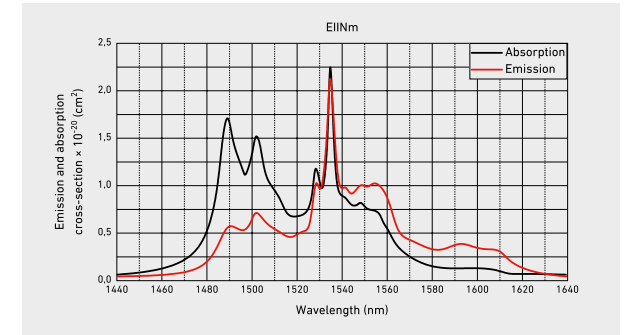
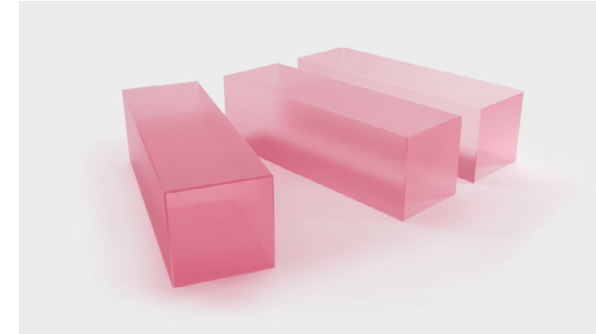
- High power CW, Q-switched and mode-locked lasers
- Thin-disk lasers

4Lasers does not provide standard product list. Please contact us for solutions and pricing.

Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	985 nm
Absorption cross-section at peak	$7,5 \times 10^{-20} \text{ cm}^2$
Absorption bandwidth at peak wavelength	5 nm
Laser wavelength	1027 nm
Lifetime of ² F _{5/2} ytterbium energy level	250 μs
Emission cross-section @1027 nm	$0,5 \times 10^{-20} \text{ cm}^2$
Refractive index @1064 nm	$n_o = 1,93, n_e = 2,1$
Crystal structure	Tetragonal
Density	4,22 g/cm ³
Mohs hardness	5
Thermal conductivity	$-5 \text{ Wm}^{-1}\text{K}^{-1}$
dn/dT	$8,41 \times 10^{-6} \text{ (IIC) K}^{-1}, 15,5 \times 10^{-6} \text{ (IIIA) K}^{-1}$
Thermal expansion coefficient	$1,5 \times 10^{-6} \text{ (IIA) K}^{-1}, 8,2 \times 10^{-6} \text{ (IIC) K}^{-1}$
Typical doping level	1-3 at. %

Er:KYW crystals



Er³⁺:KYW is a promising laser material for eye-safe emission at the wavelength of 1609 nm, which can be resonantly diode-pumped into the upper laser manifold at 1534 nm. Due to the low quantum defect high-slope efficiencies of >80% can be achieved with direct fiber laser

or InGaAs/InP pumping. Because of a broad and smooth emission in the spectral range of 1570-1630 nm mode-locked "eye-safe" laser can be realized.

Main features

- Strong absorption bandwidth near 1534 nm corresponding to InGaAsP/InP laser diode emission
- Wide emission bandwidth near 1600 nm
- Custom crystals available upon request

Application examples

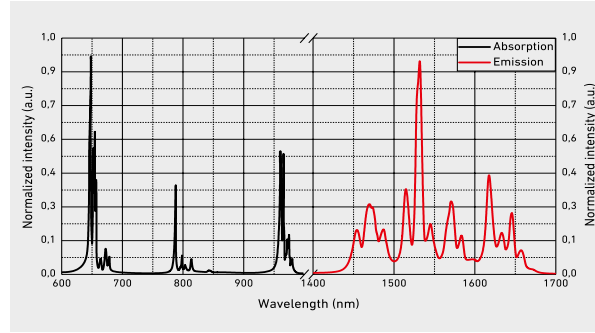
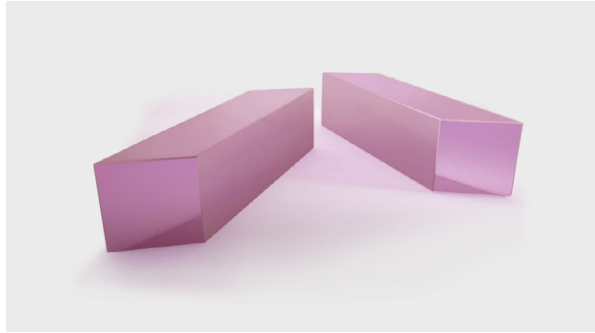
- In-band pumped "eye-safe" CW, Q-switched and mode-locked lasers
- In-band pumped "eye-safe" waveguide lasers

4Lasers does not provide standard product list. Please contact us for solutions and pricing.

Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	1534 nm
Absorption cross-section at peak	$2,4 \times 10^{-20} \text{ cm}^2$
Absorption bandwidth at peak wavelength	3 nm
Laser wavelength	1609 nm
Lifetime of ⁴ F _{3/2} erbium energy level	3,1 ms
Emission cross-section @1609 nm	$0,4 \times 10^{-20} \text{ cm}^2$
Refractive index	$n_o = 2,05, n_m = 2,01, n_p = 1,97$
Crystal structure	Monoclinic
Density	6,5 g/cm ³
Mohs hardness	4-5
Thermal conductivity	$-3,5 \text{ Wm}^{-1}\text{K}^{-1}$
Typical doping level	<20 at. %

Er:YAG crystals



Er³⁺:YAG crystal is an attractive laser material for eye-safe emission at wavelengths of 1617 and 1645 nm which can be resonantly diode-pumped into the upper laser manifold at 1470 nm and 1532 nm. Due to the low quantum defect high slope efficiencies of >80%

can be achieved with direct fiber laser or InGaAs/InP pumping. By using heavily erbium doped (~50 at.%) YAG crystal efficient CW laser operation at ~3 μm can be obtained.

Main features

- Isotropic crystal (cubic symmetry)
- High thermal conductivity
- Strong absorption bandwidth near 1470 nm corresponding to InGaAsP/InP laser diode emission
- Emission spectra at 1617 nm is free from absorption in the atmosphere
- Custom crystals available upon request

Application examples

- CW and Q-switched eye-safe (~1,6 μm) in-band pumped lasers with nearly quantum defect limited efficiency for military applications including LIDAR, telemetry, or active imaging
- Channel waveguide eye-safe (~1,6 μm) in-band pumped lasers with diffraction-limited output for long-distance telemetry and ranging
- CW and Q-switched ~3 μm lasers for oral surgery, dentistry, implant dentistry, and otolaryngology

Standard specifications

ER:YAG CRYSTALS	
Orientation	[111]
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<10 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 S-D
Surface flatness	<λ/10@632,8 nm
Coatings	Uncoated, coatings available upon request
Mount	Unmounted

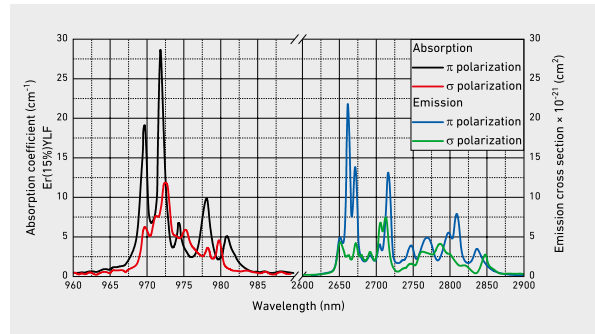
Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	960, 1470, 1532 nm
Absorption cross-section at peak wavelength	-1,0 × 10 ⁻²⁰ cm ² @1470 nm
Absorption bandwidth at peak wavelength	-2-3 nm @ 1470 nm
Laser wavelength	1617, 1645, 2940 nm
Lifetime of ⁴ I _{13/2} and I _{11/2} erbium energy level	6,0 ms (⁴ I _{13/2}), 0,1 ms (I _{11/2})
Emission cross-section at wavelength	2,6 × 10 ⁻²⁰ @2940 nm 5,2 × 10 ⁻²¹ @1645 nm
Refractive index @1064 nm	1,82
Crystal structure	Cubic
Density	4,56 g/cm ³
Mohs hardness	8,5
Thermal conductivity	-13 Wm ⁻¹ K ⁻¹
dn/dT @1064 nm	7,8 × 10 ⁻⁴ K ⁻¹
Thermal expansion coefficient	-7 × 10 ⁻⁶ K ⁻¹
Typical doping level	<1 at.% (for ~1,6 μm lasers) <50 at.% (for ~3 μm lasers)

Standard products

FACE DIMENSIONS	LENGTH	END FACES	DOPING	COATINGS	SKU	PRICE
5 x 5 mm	3 mm	Brewster-angle cut	0,15%	Uncoated	7852	Request
	2 mm	Brewster-angle cut	50%	Uncoated	7853	500 €

Er:YLF crystals



Er³⁺:YLF crystals are characterized by a low phonon frequency, which decreases the probability of non-radiative multi-phonon relaxations, therefore increases the luminescence quantum efficiency. Long lifetime of laser emitting levels allow higher energy storage, which is useful for the Q-switched lasing regime. High bandgap along with a

low phonon energy leads to a very wide transparency range, which is possibly from VUV to 10 μm region. Negative Er³⁺:YLF thermo-optic coefficient is an advantage since it reduces the thermal-lensing effect and improves beam shape as well as stability at high average pump power.

Main features

- A low phonon frequency
- Long lifetimes of the laser emitting levels
- Wide transparency range (from the VUV to the 10 μm region)
- Negative thermo-optic coefficient
- Custom crystals available upon request

Application examples

- CW and Q-switched ~3 μm lasers for oral surgery, dentistry, implant dentistry, and otolaryngology
- Up-conversion visible lasers for display technology, medicine (diagnosis and treatment)

Standard specifications

ER:YLF CRYSTALS	
Orientation	a-cut
Clear aperture	>90%
Face dimensions tolerance	+0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<10 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 S-D
Surface flatness	<λ/10 @ 632,8 nm
Coatings	Uncoated, coatings available upon request
Mount	Unmounted

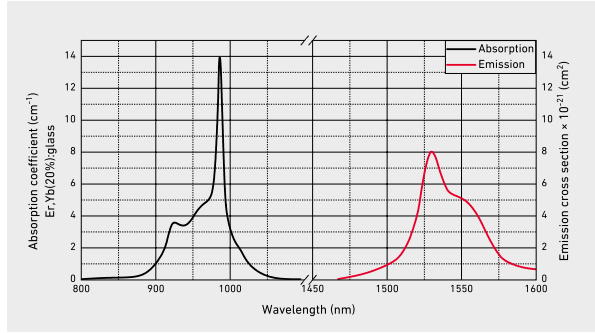
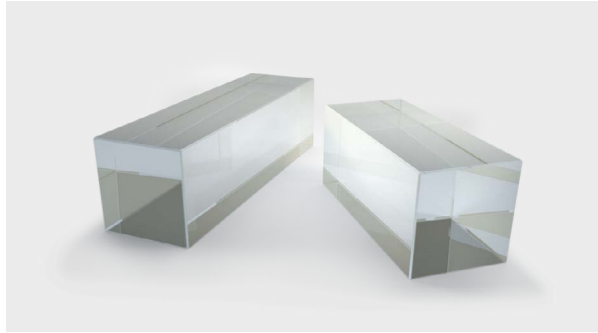
Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	972 nm
Absorption coefficient at peak wavelength	28 cm ⁻¹
Absorption bandwidth at peak wavelength	-1 nm
Laser wavelength	2810 nm
Lifetime of ⁴ I _{1/2} erbium energy level	4 ms
Emission cross-section @2800 nm	1,5 × 10 ⁻²⁰ cm ²
Refractive index @2070 nm	n _o = 1,442, n _e = 1,464
Crystal structure	tetragonal
Density	3,95 g/cm ³
Mohs hardness	5
Thermal conductivity	-5 Wm ⁻¹ K ⁻¹
dn/dT	-2 × 10 ⁻⁶ (Ila) K ⁻¹ , -4,1 × 10 ⁻⁶ (Ilc) K ⁻¹
Thermal expansion coefficient	8 × 10 ⁻⁶ K ⁻¹
Typical doping level	15 at. %

Standard products

FACE DIMENSIONS	LENGTH	END FACES	DOPING	COATINGS	SKU	PRICE
ø5 mm	5 mm	Brewster-angle cut	15%	Uncoated	7843	540 €
5 x 5 mm	5 mm	Brewster-angle cut	15%	Uncoated	7842	540 €

Er, Yb:phosphate glass



Er³⁺, Yb³⁺ co-doped phosphate glass (Er,Yb:phosphate glass) is a well-known and commonly used active medium for lasers emitting in the “eye-safe” spectral range of 1,5-1,6 μm. Phosphate glass combines a long lifetime (~8 ms) of ⁴I_{13/2} Er³⁺ upper laser level with a low (2-3 ms) lifetime of ⁴I_{1/2}Er³⁺ level that is in resonance with

Yb³⁺ ²F_{5/2} excited state. Fast non-radiative multi-phonon relaxation from ⁴I_{11/2} to ⁴I_{13/2} level greatly decreases the back-energy transfer and up-conversion losses due to the interaction between Yb³⁺ and Er³⁺ ions, excited at the ²F_{5/2} and the ⁴I_{11/2} levels, respectively.

Main features

- Long lifetime of the ⁴I_{13/2} erbium energy level
- High Yb to Er energy transfer efficiency
- High absorption and emission cross-sections
- Wide absorption and emission bandwidths
- Custom crystals available upon request

Application examples

- Passively Q-switched lasers for laser rangefinders, LIDAR, and LIBS systems

Standard specifications

ER, YB:PHOSPHATE GLASS CRYSTALS	
Clear aperture	>90%
Face dimensions tolerance	+0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<10 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 S-D
Surface flatness	<λ/10@632,8 nm
Coatings	AR(R<0,5%)@940 nm + AR(R<0,2%)@1535 nm on both faces
Laser induced damage threshold	>10 J/cm²@1535 nm, 10 ns
Mount	Unmounted

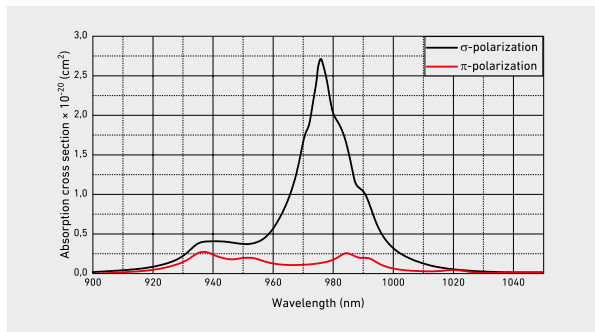
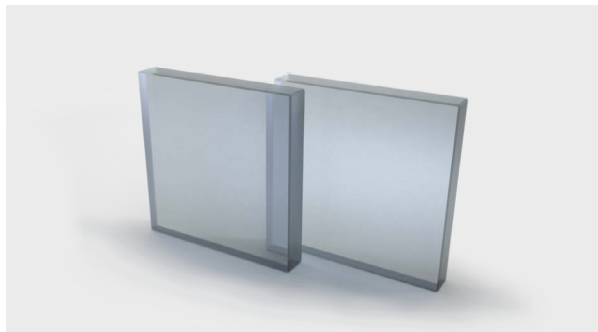
Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	970 nm
Absorption cross-section at peak wavelength	1,7 × 10 ⁻²⁰ cm ²
Absorption bandwidth at peak wavelength	20 nm
Laser wavelength	1534 nm
Lifetime of ⁴ I _{13/2} erbium energy level	7,9 ms
Emission cross-section @1534 nm	8 × 10 ⁻²¹ cm ²
Yb to Er energy transfer efficiency	>90 %
Refractive index @1534 nm	1,52
Crystal structure	-
Density	2,93 g/cm ³
Mohs hardness	6-7
Thermal conductivity	0,85 Wm ⁻¹ K ⁻¹
dn/dT	-2,1 × 10 ⁻⁶ K ⁻¹
Thermal expansion coefficient	12,4 × 10 ⁻⁶ K ⁻¹
Typical doping level	0,3-1,3 × 10 ²⁰ cm ⁻³ [Er] 1,7-4 × 10 ²¹ cm ⁻³ [Yb]

Standard products

FACE DIMENSIONS	LENGTH	END FACES	DOPING	COATINGS	SKU	PRICE
3 x 3 mm	5 mm	Brewster-angle cut	Yb 20%, Er 1%	Uncoated	7824	370 €
		Right-angle cut	Yb 20%, Er 1%	AR/AR@940 nm + 1535 nm	7823	395 €
	10 mm	Brewster-angle cut	Yb 20%, Er 0,5%	Uncoated	7822	370 €
		Right-angle cut	Yb 20%, Er 0,5%	AR/AR@940 nm + 1535 nm	7821	395 €

Er, Yb:YAB crystals



Er³⁺, Yb³⁺ co-doped yttrium-aluminum borate (Er, Yb:YAB) crystal is an alternative to commonly used Er,Yb:phosphate glass as an active medium of "eye-safe" (1,5-1,6 μm) lasers with a high average output power in CW and pulsed modes. It is characterized by high thermal conductivities of 7,7 Wm⁻¹K⁻¹ and 6 Wm⁻¹K⁻¹ along a-axis and c-axis, respectively. It also features a highly effective Yb³⁺ to Er³⁺ energy

transfer (~94%) and weak up conversion losses due to the very short lifetime of ⁴I_{11/2} excited state (~80 ns) facilitated by a high maximum phonon energy of the host material (hν_{max} ~ 1500 cm⁻¹). A strong and wide (~17 nm) absorption band is observed at 976 nm that coincides with the emission spectrum of InGaAs laser diodes.

Main features

- Uniaxial crystal with trigonal structure
- High thermal conductivity
- Wide absorption bandwidth near 976 nm
- High absorption and emission cross-sections
- Extremely high Yb³⁺ to Er³⁺ energy transfer efficiency

Application examples

- High power eye-safe (~1,5 μm) CW lasers for metrology
- High-repetition rate passively Q-switched lasers for LIDAR and LIBS systems
- Ultrashort mode-locked lasers for telecom systems

Standard specifications

ER, YB:YAB CRYSTALS	
Orientation	c-cut
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<10 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,15 mm at 45°
Surface quality	10-5 S-D
Surface flatness	<λ/10@632,8 nm
Coatings	AR@R<1% @940 nm + AR(R<0,25% @1480-1600 nm
Laser induced damage threshold	>10 J/cm ² @1550 nm, 10 ns
Mount	Unmounted

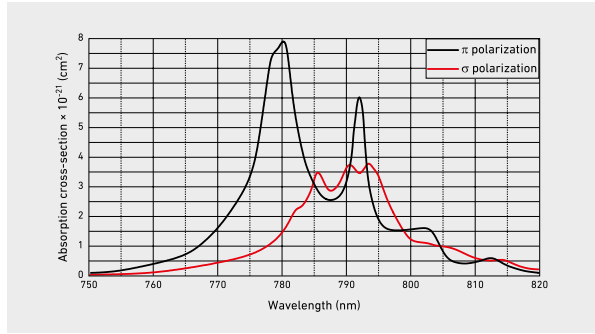
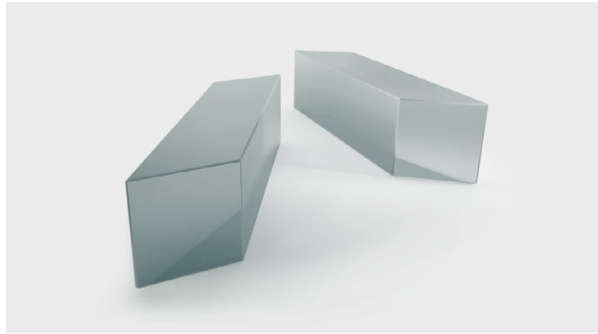
Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	976 nm
Absorption cross-section at peak wavelength	2,7 × 10 ⁻²⁰ cm ²
Absorption bandwidth at peak wavelength	17 nm
Laser wavelength	1522, 1531, 1543, 1550, 1602 nm
Lifetime of ⁴ I _{13/2} erbium energy level	0,32 ms
Emission cross-section @1531 nm	2,5 × 10 ⁻²⁰ cm ²
Yb to Er energy transfer efficiency	>90 %
Refractive index @632.8 nm	n _o = 1,7757, n _e = 1,7015
Crystal structure	trigonal
Density	3,84 g/cm ³
Mohs hardness	7,5
Thermal conductivity	7,7 (IIa), 6 (IIc) Wm ⁻¹ K ⁻¹
dn/dT	1,4 × 10 ⁻⁶ (IIa), 4,8 × 10 ⁻⁶ (IIc) K ⁻¹
Thermal expansion coefficient	2 × 10 ⁻⁶ (IIa), 9,5 × 10 ⁻⁶ (IIc) K ⁻¹
Typical doping level	1-2 at.% [Er] 8-15 at.% [Yb]

Standard products

FACE DIMENSIONS	LENGTH	END FACES	DOPING	COATINGS	SKU	PRICE
3 x 3 mm	1 mm	Brewster-angle cut	12% Yb, 1,5% Er	Uncoated	7068	540 €
		Right-angle cut	12% Yb, 1,5% Er	AR/AR@976 nm + 1480-1600 nm	7065	590 €
	2 mm	Brewster-angle cut	12% Yb, 1,5% Er	Uncoated	7069	540 €
		Right-angle cut	12% Yb, 1,5% Er	AR/AR@976 nm + 1480-1600 nm	7066	590 €
	3 mm	Brewster-angle cut	12% Yb, 1,5% Er	Uncoated	7070	540 €
		Right-angle cut	12% Yb, 1,5% Er	AR/AR@976 nm + 1480-1600 nm	7067	590 €

Tm:YLF crystals



Tm³⁺:YLF crystal features high absorption peaks conveniently located for diode pumping around 792 nm and exhibits a cross-relaxation process, which creates two ions in the upper laser level for each pump photon absorbed. Tm³⁺:YLF lasers are ideal pump sources for Ho³⁺:YAG lasers. This is due to a good overlap of Tm³⁺:YLF emission

and Ho³⁺:YAG absorption spectra and capacity of producing linearly polarized output. What is more, the refractive index of Tm³⁺:YLF decreases with temperature, leading to a negative thermal lens that is partly compensated by a positive lens effect due to end face bulging.

Main features

- Strong absorption bands for laser diode pumping
- Weak thermal lensing
- High polarization purity
- Custom crystals available upon request

Application examples

- LIDAR systems for remote sensing applications
- Pump source for Ho³⁺:YAG lasers

Standard specifications

TM:YLF CRYSTALS	
Orientation	a-cut
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<10 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 S-D
Surface flatness	<λ/10 @ 632,8 nm
Coatings	AR(R<0,5%)@792 nm + AR(R<0,5%) @1800-1960 nm on both faces
Laser induced damage threshold	>10 J/cm ² @1900 nm, 10 ns
Mount	Unmounted

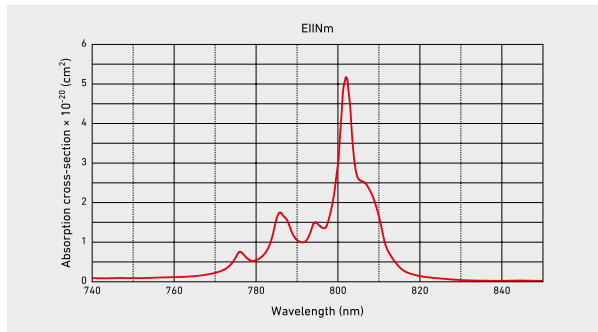
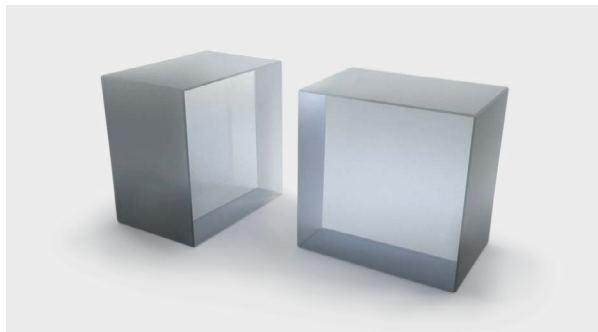
Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	792 nm
Absorption cross-section at peak	0,55 × 10 ⁻²⁰ cm ²
Absorption bandwidth at peak wavelength	16 nm
Laser wavelength	1900 nm
Lifetime of ³ F ₄ thulium energy level	16 ms
Emission cross-section @1900 nm	0,4 × 10 ⁻²⁰ cm ²
Refractive index @1064 nm	n _o = 1,448, n _e = 1,470
Crystal structure	tetragonal
Density	3,95 g/cm ³
Mohs's hardness	5
Thermal conductivity	6 Wm ⁻¹ K ⁻¹
dn/dT	-4,6 × 10 ⁻⁶ (IIC) K ⁻¹ , -6,6 × 10 ⁻⁶ (IIa) K ⁻¹
Thermal expansion coefficient	10,1 × 10 ⁻⁶ (IIC) K ⁻¹ , 14,3 × 10 ⁻⁶ (IIa) K ⁻¹
Typical doping level	2-4 at. %

Standard products

FACE DIMENSIONS	LENGTH	END FACES	DOPING	COATINGS	SKU	PRICE
3 x 3 mm	8 mm	Brewster-angle cut	3%	Uncoated	7817	540 €
		Right-angle cut	3%	AR/AR@792 nm + 1800-1960 nm	7816	590 €

Tm:KYW crystals



Double tungstate crystals are optically biaxial and their optical properties have to be described within the frame of optical indicatrix axes (N_p , N_m and N_g). Advantages of Tm-doped KYW crystals include a broad fluorescence band, a large emission cross section and

a relatively low upper level lifetime. Such properties combination of properties is very promising for generation of femtosecond pulses in solid-state laser systems.

Main features

- Broad fluorescence band
- Large emission cross-section
- Relatively low upper-level lifetime
- Custom crystals available upon request

Application examples

- CW and Q-switched lasers emitting near 2 μm for application in surgery, range finding and environmental monitoring
- 2 μm wavelength region femtosecond lasers

Standard specifications

TM:KYW CRYSTALS	
Orientation	N_g -cut
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	$\pm 0,1$ mm
Parallelism error	<10 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 S-D
Surface flatness	< $\lambda/10 @ 632,8$ nm
Coatings	AR(R<0,5%)@802 nm + AR(R<0,5%)@1900-2000 nm on both faces
Laser induced damage threshold	>10 J/cm ² @1900 nm, 10 ns
Mount	Unmounted

Properties

SPECTROSCOPIC AND THERMO-MECHANICAL PROPERTIES	
Absorption peak wavelength	802 nm
Absorption cross-section at peak	$5,2 \times 10^{-20} \text{ cm}^2$
Absorption bandwidth at peak wavelength	5,5 nm
Laser wavelength	1910 nm
Lifetime of 3F_4 energy level	1,1 ms
Emission cross-section @1910 nm	$1,15 \times 10^{-20} \text{ cm}^2$
Refractive index @1040nm	$n_p = 2,05, n_m = 2,01, n_g = 1,97$
Crystal structure	Monoclinic
Density	6,5 g/cm ³
Mohs hardness	4-5
Thermal conductivity	-3,3 Wm ⁻¹ K ⁻¹
dn/dT	$dn_m/dT = -9,2 \times 10^{-6} \text{ K}^{-1}$
Thermal expansion coefficient	$\alpha_p = 1,83 \times 10^{-6} \text{ K}^{-1}, \alpha_m = 10,29 \times 10^{-6} \text{ K}^{-1}, \alpha_g = 15,94 \times 10^{-6} \text{ K}^{-1}$
Typical doping level	-5 at. %

Standard products

FACE DIMENSIONS	LENGTH	END FACES	DOPING	COATINGS	SKU	PRICE
3 x 3 mm	2 mm	Brewster-angle cut	5%	Uncoated	7841	Request
		Right-angle cut	5%	AR/AR@802 nm +1900-2000 nm	7840	Request