Crystal (P115–P136)

Laser Crystal

Nd:YAG

Invented in the sixties of the last century, Nd:YAG has been and continue to be the most widely used laser crystal for solid-state crystal material. Its laser parameters are a good compromise between the strengths and weaknesses of its competition. Nd:YAG crystals are used in all types of solid-state lasers. Compared with others laser crystals, its fluorescence lifetime is twice more than Nd:YVO4 , and thermal conductivity is also better.

Specifications

Nd Dopant Level	0.5 - 1.1 atm%
Orientation	<111> crystalline direction (±0.5deg)
Dimension Tolerances	Diameter: ±0.05mm Length: ±0.5mm
Wavefront Distortion	λ/8@633nm
Surface Flatness	λ/10@633nm
Parallelism	<10 arc seconds
Perpendicularity	<5 arc minutes
Surface Quality	10/5 Scratch and Dig
Clear Aperture	>90%
Chamfer	<0.1mm@45deg
AR Coating	Reflectivity R<0.25%@1064nm per surface Damage threshold over 750MW/cm^2@1064nm, 10ns and 10Hz
HR Coating	Standard R>99.8%@1064nm and R<5%@808nm
Extinction Ratio	Rods with diameter from 3mm to 6.35mm and with length to 100mm: >30dB Rods with diameter from 7mm to 10mm and with length to 100mm: >28dB

Standard Product

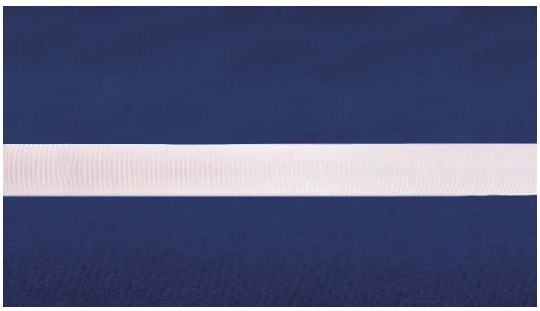
Part No.	Diameter(mm)	Length(mm)	Doping(%)	End Wedge (Deg)	Coating
NYG9003-65	3.0	65.0	0.6	0/0	AR/AR@1064nm
NYG9003-78	3.0	78.0	0.6	0/0	AR/AR@1064nm
NYG9102-25	2.0	25.0	1.0	0/0	AR/AR@1064nm
NYG9103-50	3.0	50.0	1.0	0/0	AR/AR@1064nm
NYG9103-65	3.0	65.0	1.0	0/0	AR/AR@1064nm
NYG9104-50	4.0	50.0	1.0	0/0	AR/AR@1064nm
NYG9104-120	4.0	120.0	1.0	0/0	AR/AR@1064nm
NYG9105-85	5.0	85.0	1.0	0/0	AR/AR@1064nm
NYG9106-120	6.0	120.0	1.0	0/0	AR/AR@1064nm
NYG9107-120	7.0	120.0	1.0	0/0	AR/AR@1064nm
NYG9107-145	7.0	145.0	1.0	0/0	AR/AR@1064nm
NYG9107-155	7.0	155.0	1.0	0/0	AR/AR@1064nm
NYG9107-165	7.0	165.0	1.0	0/0	AR/AR@1064nm
NYG9107-185	7.0	185.0	1.0	0/0	AR/AR@1064nm
NYG9108-100	8.0	100.0	1.1	0/0	AR/AR@1064nm
NYG9108-145	8.0	145.0	1.0	0/0	AR/AR@1064nm
NYG9108-155	8.0	155.0	1.0	0/0	AR/AR@1064nm
NYG9108-165	8.0	165.0	1.0	0/0	AR/AR@1064nm
NYG9108-185	8.0	185.0	1.0	0/0	AR/AR@1064nm

Grooved Nd:YAG

Compared with the common Nd:YAG laser rods, the grooved Nd:YAG laser rods has the following advantages.

Main Features

- The quality of the beam has been improved
- Thermal effect has been reduced
- The efficiency of Grooved Rod has been improved by 10%-20%



Specifications

Nd Dopant Level	0.5 - 1.1 atm%
Orientation	<111> crystalline direction (±0.5deg)
Dimension Tolerances	Diameter: ±0.05mm Length: ±0.5mm
Wavefront Distortion	λ/8@633nm
Surface Flatness	λ/10@633nm
Parallelism	<10 arc seconds
Perpendicularity	<5 arc minutes
Surface Quality	10/5 Scratch and Dig
Clear Aperture	>90%
Chamfer	<0.1mm@45deg
AR Coating	Reflectivity R<0.25%@1064nm per surface Damage threshold over 750MW/cm^2@1064nm, 10ns and 10Hz Other coating is per your request
Extinction Ratio	Rods with diameter from 3mm to 6.35mm and with length to 100mm: >30dB Rods with diameter from 7mm to 10mm and with length to 100mm: >28dB

Standard Product

Part No.	Diameter(mm)	Length(mm)	Doping(%)	End Wedge (Deg)	Coating
GNG9107-165	7.0	165.0	1.0	0/0	AR/AR@1064nm
GNG9107-185	7.0	185.0	1.0	0/0	AR/AR@1064nm
GNG9108-165	8.0	165.0	1.0	0/0	AR/AR@1064nm
GNG9108-185	8.0	185.0	1.0	0/0	AR/AR@1064nm

Nd:Ce:YAG

Nd:Ce:YAG is an excellent laser material widely used for no-water cooling and miniature laser systems. In double doped Nd:Ce:YAG crystals Cerium are chosen as sensitizer for Nd3+ ions because of its strong absorption in UV spectral region at flash lamp pumping and efficient energy transfer to the Nd3+ excited state. As a result, thermal distortion in Nd: Ce:YAG is low and the output laser energy is greater than that in Nd:YAG at the same pumping. Therefore it is possible to realize high power lasers with good beam quality. Lasing wavelength at 1064 nm, laser damage threshold and thermal conductivity of the Nd: Ce:YAG crystals are the same as for Nd:YAG. It is the most ideal laser material for the air cooling lasers .It is suitable for different modes of operation (pulsed, Q-switched, mode locked) and high-average power lasers.

Main Features

- High optical quality
- High efficiency
- Low threshold
- Good thermal stability
- Good anti-violet radiation property

Specifications

Dopant concentration	Nd:1.1~1.4at%, Ce:0.05~0.1at%
Orientation	[111]±5°
Rod Sizes	Diameter:3~6mm, Length:40~100mm
Diameter Tolerance	+0/-0.02mm
Length Tolerance	+0.5/-0mm
Surface Flatness	<λ/10@632.8nm
Wavefront Distortion	<λ/10@632.8nm per inch
Surface Quality	10/5 Scratch and Dig
Clear Aperture	>95%
Parallelism	<10 arc seconds
Perpendicularity	<5 arc minutes
Chamfer	0.1mm@45°
Barrel Finish	Ground Finish with 400# Grit
Extinction Ratio	>30dB
Anti Reflection Coating	R<0.15%@1064nm per surface
High Reflection Coating	Standard HR coating with R>99.8%@1064nm and R<5%@808nm

Standard Product

Part No.	Diameter(mm)	Length(mm)	Doping(%)	End Wedge (Deg)	Coating
NCG9104-50	4.0	50.0	1.0	0/0	AR/AR@1064nm
NCG9105-80	5.0	80.0	1.0	0/0	AR/AR@1064nm
NCG9105-85	5.0	85.0	1.0	0/0	AR/AR@1064nm
NCG9107-100	7.0	100.0	1.0	0/0	AR/AR@1064nm

Diffusion Bonded Cr:YAG+Nd:YAG Rod

The diffusion bonded Cr:YAG+Nd:YAG Rod consists of one Nd:YAG crystal and one or two Cr:YAG absorber. They are combined by optical contact method and further bonded under high temperature. The diffusion bonded Cr:YAG+Nd:YAG Rod helps to decrease thermal lens effect considerably in high power solid state Laser.

Main Features

- Improve beam quality
- High damage threshold
- Decrease thermal effect
- Improve efficiency
- Compact size

Capabilities

Nd:YAG Doping	0.4-1.1%
Intrinsic Loss	0.1%cm^{-1}
Scattering Sites	invisible, probed with a He-Ne laser
Diameter Tolerance	+0/-0.02mm
Length Tolerance	+0.5/-0mm
Wavefront Distortion	<λ/10 per inch @632.8nm
Surface Flatness	<λ/10@632.8nm
Surface Quality	10/5 Scratch and Dig
Clear Aperture	>95%
Parallelism	<10 arc seconds
Perpendicularity	<5 arc minutes
Chamfer	0.1mm@45°
Barrel Finish	Ground Finish with 400# Grit

Nd:YVO_4

Nd:YVO_4 crystal is one of the most efficient laser host crystal currently existing for diode laser pumped solid state lasers. Its large stimulated emission cross-section at lasing wavelength, high absorption coefficient and wide absorption bandwidth at pump wavelength, high laser induced damage threshold as well as good physical, optical and mechanical properties make Nd:YVO_4 an excellent crystal for high power, stable and cost effective diode pumped solid-state lasers.

Main Features

- Low lasing threshold and high slope efficiency
- Low dependency on pump wavelength
- Large stimulated emission cross-section at lasing wavelength
- High absorption over a wide pumping wavelength bandwidth
- Optically uniaxial and large birefringence emits polarized laser

Typical Applications

- For Single-longitudinal-mode output and compact design
- Diode laser-pumped Nd:YVO_4 compact laser and its frequency-doubled green, red or blue laser will be the ideal laser tools of machining, material processing, spectroscopy, wafer inspection, light show, medical diagnostics, laser printing and other most widespread applications

Specifications

Nd Dopant Level	0.1 - 5.0atm%
Scattering	Invisible, probed with a He-Ne laser
Orientation Tolerance	±0.5deg
Dimensional Tolerance	±0.1mm
Surface Flatness	λ/10@633nm
Wavefront Distortion	λ/8@633nm
Surface Quality	10/5 Scratch and Dig
Parallelism	<10 arc seconds
Clear Aperture	>90%
End-faces Configuration	Plano/Plano
Intrinsic Loss	< 0.1%cm^{-1}
Coating	AR1064&HT808: R<0.1%@1064nm, R<5%@808nm HR1064&HT808&HR532: R>99.8%@1064nm, R<5%@808nm, R>99%@532nm AR1064: R<0.1%@1064nm

Standard Product

Part No.	Dimension(mm)	Doping(%)	Cut Angle	Coating S1	Coating S2
NYV1301	3.0*3.0*1.0	1.0	a-cut	AR1064&HT808	AR1064
NYV5301	3.0*3.0*1.0	0.5	a-cut	AR1064&HT808	AR1064
NYV1303	3.0*3.0*3.0	1.0	a-cut	AR1064&HT808	AR1064
NYV1305	3.0*3.0*5.0	1.0	a-cut	AR1064&HT808	AR1064
NYV1307	3.0*3.0*7.0	1.0	a-cut	AR1064&HT808	AR1064
NYV5312	3.0*3.0*12.0	0.5	a-cut	AR1064&HT808	AR1064
NYV2312	3.0*3.0*12.0	0.27	a-cut	AR1064&HT808	AR1064
NYV7404	4.0*4.0*4.0	0.7	a-cut	AR1064&HT808	AR1064
NYV5407	4.0*4.0*7.0	0.5	a-cut	AR1064&HT808	AR1064
NYV1301	3.0*3.0*1.0	1.0	a-cut	AR1064&HT808	AR1064
NYV1301-HR1	3.0*3.0*1.0	1.0	a-cut	HR1064&HT808	AR1064
NYV1301-HR2	3.0*3.0*1.0	1.0	a-cut	HR1064&HT808&HR532	AR1064
NYV3305	3.0*3.0*0.5	3.0	a-cut	AR1064&HT808	AR1064
NYV3305-HR1	3.0*3.0*0.5	3.0	a-cut	HR1064&HT808	AR1064
NYV3305-HR2	3.0*3.0*0.5	3.0	a-cut	HR1064&HT808&HR532	AR1064

Nd:$GdVO_4$

Nd:$GdVO_4$ is one of the most efficient laser host crystals currently existing for diode pumped configuration . Its large stimulated emission cross-section at lasing wavelength, high absorption coefficient and wide absorption bandwidth at pump wavelength, good thermal conductivity, high laser induced damage threshold as well as good physical, optical and mechanical properties make Nd:$GdVO_4$ an excellent crystal for high power, stable and cost-effective diode pumped solid-state lasers.

Main Features

- High absorption coefficient and wide bandwidth at pump wavelength
- Large stimulated emission cross section at laser wavelength
- Low dependency on pump wavelength
- Good thermal conductivity
- High laser induced damage threshold
- Strongly-polarized laser output
- Low lasing threshold and high slope efficiency

Capabilities

Nd-dopant	0.2atm%~3.0atm%
Orientation	±0.5deg
Scattering Sites	invisible, probed with a He-Ne laser
Dimensional tolerance	±0.1mm
Wavefront Distortion	<λ/8@633nm
Surface flatness	<λ/10@633nm
Parallelism	<10 arc seconds
Perpendicularity	<5 arc minutes
Surface quality	better than 20/10 Scratch/Dig per MIL-O-1380A
Clear aperture	95%
Chamfer	0.15x45°
Damage threshold	>15J/cm^2(uncoated), >700MW/cm^2 (coated)
End-faces Configuration	Plano/Plano

Nonlinear Crystal

BBO

BBO (beta-BaB_2O_4) is a nonlinear optical crystal which combines a number of unique features. These features include wide transparency and phase matching ranges, large nonlinear coefficient, high damage threshold and excellent optical homogeneity. Therefore, BBO provides an attractive solution for various nonlinear optical applications.

BBO crystal is also an excellent electro-optic crystal for high power applications at the wavelength range from 200nm to 2500nm. It can be used for Q-Switching in a CW diode pumped Nd:YAG laser with average power>50W.

Main Features

- Good mechanical and physical properties
- Broad phase-matchable second-harmonic-generation (SHG) range from 409.6 nm to 3500 nm
- Wide transmission region from 190 nm to 3500 nm
- Large effective SHG coefficient
- High damage threshold of 10 GW/cm2 for 100 ps pulse-width at 1064 nm
- High optical homogeneity with $\Delta n=10^{-6}$/cm
- Wide temperature-bandwidth of about 55℃ (for type I SHG 1064 nm)

Typical Applications

- Second, third, fourth and fifth harmonic generation of Nd:YAG and Nd:YLF laser
- Frequency-doubling, -tripling and -mixing of Dye lasers
- Second, third and fourth harmonic generation of Ti:Sapphire and Alexandrite lasers
- Optical parametric amplifier (OPA) and optical parametric oscillators (OPO)
- Frequency-doubling of Argon ion, Cu-vapor and Ruby lasers
- Research and development for advanced laser techniques, including all-solid state wide-tunable lasers, ultrafast pulse lasers, and DUV lasers

Standard Parameter for Different Application

Harmonic generations of Nd:YAG lasers		
1064nm SHG-> 532nm	4x4x7mm	Type I, Theta=22.8deg, Phi=0deg
1064nm THG-> 355nm	4x4x7mm	Type I, Theta=31.3deg, Phi=0deg
1064nm THG-> 355nm	4x4x7mm	Type II, Theta=38.6deg, Phi=30deg
1064nm 4HG-> 266nm	4x4x7mm	Type I, Theta=47.6deg, Phi=0deg
1064nm 5HG-> 213nm	4x4x7mm	Type I, Theta=51.1deg, Phi=0deg
OPO and OPA pumped by harmonics of Nd:YAG lasers		
532nm Pump-> 680-2600nm	4x4x12mm	Type I, Theta=21deg, Phi=0deg
355nm Pump-> 410-2600nm	6x4x12mm	Type I, Theta=30deg, Phi=0deg
355nm Pump-> 410-2600nm	7x4x15mm	Type II, Theta=37deg, Phi=30deg
266nm Pump-> 295-2600nm	6x4x12mm	Type I, Theta=39deg, Phi=0deg
Frequency doubling of dye lasers		
670-530nm SHG-> 355-260nm	8x4x7mm	Type I, Theta=40deg, Phi=0deg
600-440nm SHG-> 300-220nm	8x4x7mm	Type I, Theta=55deg, Phi=0deg
444-410nm SHG-> 222-205nm	8x4x7mm	Type I, Theta=80deg, Phi=0deg
Harmonic generations of Ti:Sapphire lasers		
700-1000nm SHG->350-500nm	7x4x7mm	Type I, Theta=28deg, Phi=0deg
700-1000nm THG->240-330nm	8x4x7mm	Type I, Theta=42deg, Phi=0deg
700-1000nm FHG-> 210-240nm	8x4x7mm	Type I, Theta=66deg, Phi=0deg
Frequency doubling and tripling of Alexandrite lasers		
720-800nm SHG-> 360-400nm	4x4x7mm	Type I, Theta=31deg, Phi=0deg
720-800nm THG-> 240-265nm	4x4x7mm	Type I, Theta=48deg, Phi=0deg
Intracavity SHG of Ar+ laser with Brewster angle cut BBO		
514nm SHG-> 257nm	4x4x7mm	Type I, Theta=51deg, Phi=0deg
488nm SHG-> 244nm	4x4x7mm	Type I, Theta=55deg, Phi=0deg

Specifications

Dimension Tolerance	(W±0.1mm) x (H±0.1mm) x (L±0.2mm)
Angle Tolerance	Δθ<0.5°, ΔΦ<0.5°
Surface Flatness	<λ/8@633nm
Wavefront Distortion	<λ/4@633nm
Surface Quality	Better than 20/10 Scratch and Dig
Parallelism	<20 arc seconds
Perpendicularity	<5 arc minutes
Clear Aperture	>90% Central

Standard Product

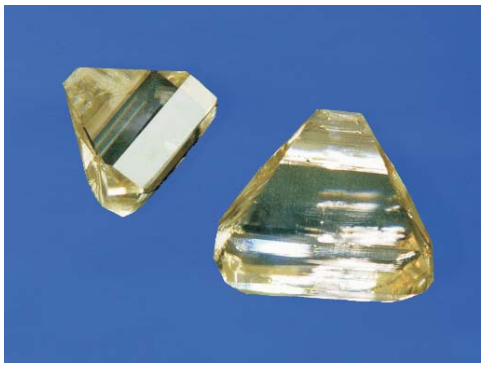
Part No.	Dimension(mm)	Theta(°)	Phi(°)	Coating	Application
BBO9001	4.0*4.0*7.0	22.8	0	AR/AR@1064&532nm	SHG@1064, Type I
BBO9002	4.0*4.0*7.0	47.6	0	AR/AR@532&266nm	4HG@1064, Type I
BBO9003	4.0*4.0*10.0	22.8	0	AR/AR@1064&532nm	SHG@1064, Type I
BBO9004	4.0*4.0*10.0	47.6	0	AR/AR@532&266nm	4HG@1064, Type I
BBO9005	5.0*5.0*2.0	29.2	0	AR/AR@800&400nm	SHG@800, Type I
BBO9006	5.0*5.0*1.0	29.2	0	AR/AR@800&400nm	SHG@800, Type I
BBO9007	5.0*5.0*0.3-0.5	29.2	0	AR/AR@800&400nm	SHG@800, Type I
BBO9008	5.0*5.0*0.1	29.2	0	AR/AR@800&400nm	SHG@800, Type I

KTP

Potassium Titanium Oxide Phosphate ($KTiOPO_4$), or KTP, is an efficient nonlinear optical crystal in the visible to infrared spectral region with relatively low cost. It has large nonlinear coefficient. The effective nonlinear optical coefficient of KTP deff at 1064nm is more than 1.5 times that of BBO.

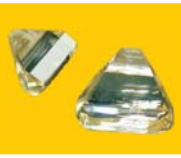
Main Features

- Wide Angular Bandwidth and Small Walk-off Angle
- Broad Temperature and Spectral Bandwidth
- High Electro-Optic (E-O) Coefficient and Low Dielectric Constant
- Large Figure of Merit for an Optical Waveguide Modulator
- Nonhygroscopic, Good Chemical and Mechanical Properties
- Efficient frequency conversion(1064nm SHG is about 80%)
- Large nonlinear optical coefficients
- High thermal conductivity
- Minimum mismatch gradient
- Low cost compare with BBO and LBO



Typical Applications

- Frequency Mixing (SFM) of Nd Laser and Diode Laser for Blue Output
- Frequency Doubling (SHG) of Nd-doped Lasers for Green/Red Output
- Parametric Sources (OPG, OPA and OPO) for 0.6um-4.5um Tunable Output
- E-O Modulators, Optical Switches, Directional Couplers
- Optical Waveguides for Integrated NLO and E-O Devices



Specifications

Angle Tolerance	Δθ<0.5°, Δφ<0.5°
Dimension Tolerance	±0.1mm
Flatness	<λ/8@633nm
wavefront Distortion	<λ/4@633nm
Parallelism	<20 arc seconds
Perpendicularity	<15 arc minutes
Surface Quality	10/5 Scratch and Dig
Clear Aperture	>95% central area
Residual Reflectivity	<0.2% at 1064nm and <0.5% at 532nm per surface
Quality Warranty Period	One year under proper use
Coating	AR/AR@1064&532nm: S1&S2 AR@1064&532nm, R<0.25%@1064nm, R<0.5%@532nm HR/AR@1064&532nm: S1 HR@1064nm&HT@532nm, R>99.8%@1064nm, R<5%@532nm S2 AR@1064&532nm, R<0.25%@1064nm, R<0.5%@532nm

Standard Product

Part No.	Dimension(mm)	Theta(°)	Phi(°)	Coating	Application
KTP9001	3.0*3.0*5.0	90	23.5	AR/AR@1064&532nm	SHG@1064,Type II
KTP9101	3.0*3.0*5.0	90	23.5	HR/AR@1064&532nm	SHG@1064,Type II
KTP9002	3.0*3.0*10.0	90	23.5	AR/AR@1064&532nm	SHG@1064,Type II
KTP9102	3.0*3.0*10.0	90	23.5	HR/AR@1064&532nm	SHG@1064,Type II
KTP9003	5.0*5.0*10.0	90	23.5	AR/AR@1064&532nm	SHG@1064,Type II
KTP9004	7.0*7.0*5.0	90	23.5	AR/AR@1064&532nm	SHG@1064,Type II
KTP9205	7.0*7.0*20.0	90	0	AR/AR@1573&1064nm	OPO@1573&1064nm

KDP & KD*P

KDP and KD*P are nonlinear optical materials, characterized by high damage threshold, good nonlinear optical coefficients and electro-optic coefficients. It can used for doubling, tripling and quadrupling of Nd:YAG laser at room temperature, and electro-optical modulators.

Main Features

- High optical damage threshold and high birefringence
- Good UV transmission
- Electro-optical modulator and Q switches
- Second, third, and fourth harmonic generation, frequency doubling of Nd:YAG laser
- High power laser frequency conversion material

Capabilities

Dimension Tolerance	±0.1mm
Angle Tolerance	Δθ<0.5°, ΔΦ<0.5°
Surface Flatness	<λ/8@633nm
Wavefront Distortion	<λ/4@633nm
Parallelism	<20 arc seconds
Perpendicularity	<15 arc minutes
Surface Quality	Better than 20/10 Scratch and Dig
Clear Aperture	>90%

$LiNbO_3$

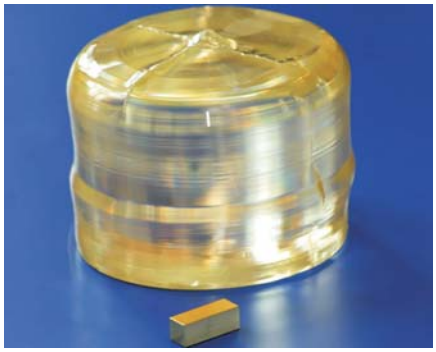
Lithium Niobate($LiNbO_3$) Crystal is widely used as frequency doublers for wavelength >1um and optical parametric oscillators (OPO) pumped at 1064 nm as well as quasi-phase-matched (QPM) devices. Due to its large Electro-Optic(E-O) and Acousto-Optic(A-O) coefficients, $LiNbO_3$ is also widely used as electro-optic modulator and Q-switch for Nd:YAG, Nd:YLF and Ti:Sapphire lasers as well as modulator for fiber optics, etc.

Main Features

- Large Electro-Optic (E-O) coefficients
- Large Acousto-Optic (A-O) coefficients

Typical Applications

- Frequency doublers
- Optical parametric oscillators (OPO)
- Quasi-phase-matched (QPM) device
- Q-switches and modulator



Capabilities

Dimensional Tolerance	±0.1mm
Angle Tolerance	±0.5deg
Surface Flatness	<λ/8@633 nm
Wavefront Distortion	<λ/4@633nm
Surface Quality	20/10 Scratch and Dig
Parallelism	<20 arc seconds
Perpendicularity	<5 arc minutes
Clear Aperture	>90%
AR Coating	Per your request

Iron Doped Lithium Niobate Crystal

Fe:$LiNbO_3$ crystal is widely used photo refractive material with large electro-optic coefficients, high photo refractive sensitivity and high diffraction efficiency. Due to these features, Fe:$LiNbO_3$ crystals are mostly used for memory, optical storage, information processing and holography applications. The iron level we can offer is from 0.005mol% to 0.1mol%.

Magnesium Oxide Doped Lithium Niobate Crystal

Compared with $LiNbO_3$ crystal, MgO:$LiNbO_3$ crystal exhibits its particular advantages for NCPM frequency doubling (SHG) of Nd:Lasers, mixing (SFG) and optical parametric oscillators (OPOs). MgO:$LiNbO_3$ is also a good crystal for optical parametric oscillators (OPOs) and amplifiers (OPAs), quasi-phase-matched doublers and integrated waveguide. MgO:$LiNbO_3$ has similar effective nonlinear coefficients to pure $LiNbO_3$. Its Sellmeier equations (for MgO dopant 7 mol%) are:

$$No^2=4.8762+0.11554/(\lambda^2 - 0.04674) - 0.033119\lambda^2$$

$$Ne^2=4.5469+0.094779/(\lambda^2 - 0.04439) - 0.026721\lambda^2$$

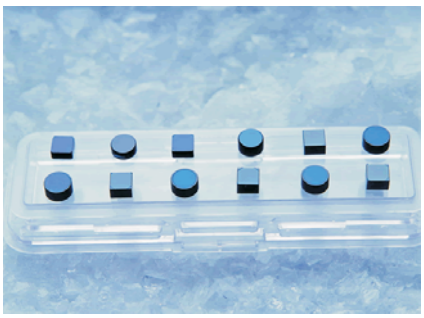
Lithium Tantalate Crystal

$LiTaO_3$ crystal is also widely used as electro-optic modulator, with NLO and E-O properties similar to those of $LiNbO_3$ but higher damage threshold (>500 MW/cm for ns pulsed).

Passive Q-Switch Crystal

Cr:YAG

$Cr^{4+}:Y_3Al_5O_{12}$ crystal is one of the most promising passive Qswitching materials for passively Q-Switching diode pumped or lamped Nd or Yb doped lasers at wavelength from 0.8 to 1.2um. Because of its chemical stability, durability, UV resistance, good thermal conductivity, high damage threshold (> 500 MW/cm) and easy operation, it will replace some traditional switching materials, such as LiF and organic Dye. The preliminary experiments of Cr :YAG showed that the pulse width of passively Q-switched lasers could be as short as 9 ns for diode pumped Nd:YAG lasers and repetition rate as high as 10kHz for diode pumped Nd:YVO_4 lasers.



Specifications

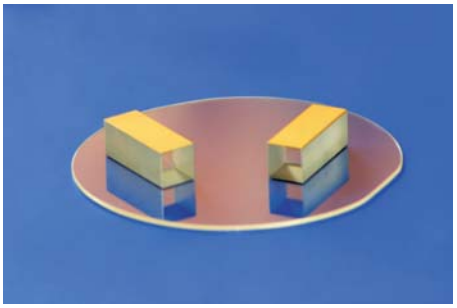
Dimension	Diameter: 3~12mm H×W: 2×2~30×30mm
Initial Transmission	5%~95%@1064nm
Dimension Tolerance	±0.1mm
Surface Flatness	<λ/10@633nm
Parallelism	<20 arc seconds
Perpendicularity	<5 arc minutes
Surface Quality	20/10 Scratch and Dig
Clear Aperture	>90%
AR Coating	<0.25%@1064nm

Standard Product

Part No.	Diameter(mm)	Transmission(%)	Coating
CYG9006-30	6.0	30	AR/AR@1064nm
CYG9006-40	6.0	40	AR/AR@1064nm
CYG9006-50	6.0	50	AR/AR@1064nm
CYG9006-60	6.0	60	AR/AR@1064nm
CYG9006-70	6.0	70	AR/AR@1064nm
CYG9006-75	6.0	75	AR/AR@1064nm
CYG9006-80	6.0	80	AR/AR@1064nm
CYG9006-85	6.0	85	AR/AR@1064nm
CYG9010-30	10.0	30	AR/AR@1064nm
CYG9010-40	10.0	40	AR/AR@1064nm
CYG9010-50	10.0	50	AR/AR@1064nm
CYG9010-60	10.0	60	AR/AR@1064nm
CYG9010-70	10.0	70	AR/AR@1064nm
CYG9010-75	10.0	75	AR/AR@1064nm
CYG9010-80	10.0	80	AR/AR@1064nm
CYG9010-85	10.0	85	AR/AR@1064nm

E-O Crystal

E-O Crystal Overview



When an electric field (E) is applied to an electro-optic (E-O) crystal, the refractive index of E-O crystal will change linearly to electric field. The phenomenon is called linear electro-optic effect. If a linearly polarized light passes through an E-O crystal, the phase retardation (¢) will be induced by (ne-no) to ¢= 2p(ne-no)L, where L is crystal length, for KD*P, again as an example, ¢ =pLn$_o^3$r$_{63}$E/l. It is clear that the phase of light will change together with electric field (E). This is called electro-optic phase modulation.

If two crossed polarizers are placed at input and output ends of E-O crystal separately, the output intensity of light will be I = I$_0$sin^2(¢/2), where I0 is input intensity. That means the intensity or amplitude of light can also be modulated by electric field. This is called amplitude modulation.

There are two kinds of E-O modulations. One is longitudinal E-O modulation if the directions of electric field and light propagation are the same. The KDP isomorphic crystals are normally used in this scheme. If the directions of electric field and light propagation are perpendicular, it is called transverse E-O modulation. The $LiNbO_3$, MgO:$LiNbO_3$, ZnO:$LiNbO_3$, BBO and KTP crystals are usually employed in this scheme.

The half-wave voltage (Vp) is defined as the voltage at ¢ = l, for example, Vp=l/($_o^3$r$_{63}$) for KD*P and Vp=ld/(2n$_o^3$r$_{22}$L) for $LiNbO_3$, where l is light wavelength and d is the distance between the electrodes.

BBO crystal is an excellent electro-optic crystal for high power applications at the wavelength range from 200nm to 2500nm. It has electro-optic coefficients g_{11}=2.7pm/v, g_{22}, g_{31}<0.1g_{11}. It can be used for Q-Switching a cw diode pumped Nd:YAG laser with average power>50W.

$LiNbO_3$ is widely used as electro-optic modulator and Q-switch for Nd:YAG, Nd:YLF and Ti:Sapphire lasers as well as modulator for fiber optics, etc. If the light propagates in z-axis and electric field applies to x-axis, the refractive retardation will be G = pLnr22V/ld. The electro-optic coefficients of $LiNbO_3$ are: r_{33} = 32 pm/V, r_{31} = 10 pm/V, r_{22} = 6.8 pm/V at low frequency and r_{33} = 31 pm/V, r_{31} = 8.6 pm/V, r_{22} = 3.4 pm/V at high electric frequency.

KTP has promising E-O and dielectric properties comparable to those of $LiNbO_3$, which makes it extremely useful to various E-O devices. When these properties are combined with high damage threshold, low optical loss at high average power, wide optical bandwidth, thermal and mechanical stability, KTP crystals are expected to replace $LiNbO_3$ crystals as E-O modulators, especially for mode-locking diode laser pumped Nd:YAG and Nd:YLF lasers as well as Ti:Sapphire and Cr:LiSrAlF6 lasers. KTP crystal was successfully used to mode lock a diode laser pumped Nd:YLF laser at 270MHz with pulse width of 15 ps and spectral band width of 73 Ghz.

The following Table gives the comparison of KTP and those commonly used E-O modulator materials.

Material			Phase			Amplitude		
	e	n	r (pm/V)	k (10^{-6}/°C)	n^7r^2/e(pm/V)^2	r (pm/V)	k (10^{-6}/°C)	n^7r^2/e(pm/V)^2
KTP	15.4	1.80	35.0	31	6130	27.0	11.7	3650
$LiNbO_3$	27.9	2.20	31.0	82	7410	20.1	42	3500
KD*P	48.0	1.47	26.4	9	178	24.0	8	178

KD*P crystal is widely applied for electro-optic application as Q-switch and Pockel cells.

Crystal	KDP	KD*P	ADP
Electro-Optic Coefficient(pm/V)	G63=10.5	G63=26.4	G41(T)=24.5
Longitudinal Half-Wave Voltage Vp(546nm)	7.65KV	2.98KV	9KV

BBO

BBO crystal is an excellent electro-optic crystal for high power applications at the wavelength range from 200nm to 2500nm. BBO has a high damage threshold and a low dielectric constant and is useful in high repetetion rate, high average power (up to 150W) diode pumped solid state lasers (DPSS lasers). BBO has significant advantages over other materials in terms of laser power handling abilities, temperature stability, and substantial freedom from piezoelectric ringing.

BBO has electro-optic coefficients g11=2.7pm/v, g22, g31<0.1g11. It can be used for Q-Switching a cw diode pumped Nd:YAG laser with average power>50W.

Specifications

Dimensional Tolerance	±0.1mm
Angle Tolerance	±0.5deg
Surface Flatness	<λ/8@633nm
Wavefront Distortion	<λ/4@633nm
Parallelism	<20 arc seconds
Perpendicularity	<5 arc minutes
Surface Quality	20/10 Scratch and Dig
Clear Aperture	>90%
Coating	Per your request

Standard Product

Part No.	Dimension(mm)	Cut Angle	End Face	Side Face
BBO9320	3.0*3.0*20.0	Z-cut	AR/AR@1064nm	Au Electrodes
BBO9420	4.0*4.0*20.0	Z-cut	AR/AR@1064nm	Au Electrodes
BBO9620	6.0*6.0*20.0	Z-cut	AR/AR@1064nm	Au Electrodes
BBO9820	8.0*8.0*20.0	Z-cut	AR/AR@1064nm	Au Electrodes
BBO9120	10.0*10.0*20.0	Z-cut	AR/AR@1064nm	Au Electrodes

KTP&KD*P

KTP has promising E-O and dielectric properties comparable to those of $LiNbO_3$, which makes it extremely useful to various E-O devices. When these properties are combined with high damage threshold, low optical loss at high average power, wide optical bandwidth, thermal and mechanical stability, KTP crystals are expected to replace $LiNbO_3$ crystals as E-O modulators, especially for mode-locking diode laser pumped Nd:YAG and Nd:YLF lasers as well as Ti:Sapphire and Cr:LiSrAlF6 lasers. KTP crystal was successfully used to mode lock a diode laser pumped Nd:YLF laser at 270MHz with pulse width of 15 ps and spectral band width of 73 Ghz.

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KTP	15.4	1.80	35.0	31	6130	27.0	11.7	3650
$LiNbO_3$	27.9	2.20	31.0	82	7410	20.1	42	3500
KD*P	48.0	1.47	26.4	9	178	24.0	8	178

Specifications

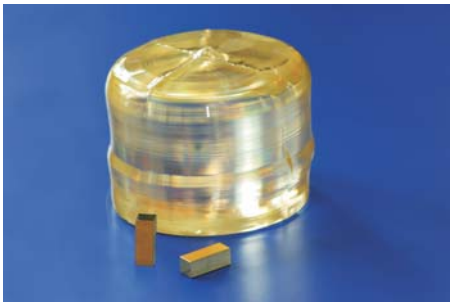
Dimensional Tolerance	±0.1mm
Angle Tolerance	±0.5deg
Surface Flatness	<λ/8@633nm
Wavefront Distortion	<λ/4@633nm
Parallelism	<20 arc seconds
Perpendicularity	<5 arc minutes
Surface Quality	20/10 Scratch and Dig
Clear Aperture	>90%
Coating	Per your request

Standard Product

Part No.	Dimension(mm)	Cut Angle	End Face	Side Face
KD*P9217	20.0*20.0*17.0	Z-cut	None	None

$LiNbO_3$ & $LiTaO_3$

Lithium Niobate ($LiNbO_3$) is widely used as electro-optic modulator and Q-switch for Nd:YAG, Nd:YLF and Ti:Sapphire lasers as well as modulator for fiber optics, etc. The transverse modulation is mostly employed for $LiNbO_3$ crystal. The light propagates in z-axis direction and electrodes are applies to x faces.



Main Features

- Large Electro-Optic (E-O) coefficients
- Q-switches and modulator

Capabilities

Dimensional Tolerance	±0.1mm
Angle Tolerance	±0.5deg
Surface Flatness	<λ/8@633nm
Wavefront Distortion	<λ/4@633nm
Parallelism	<20 arc seconds
Perpendicularity	<5 arc minutes
Surface Quality	20/10 Scratch and Dig
Clear Aperture	>90%
AR Coating	R<0.25%@1064nm

Standard Product

Part No.	Dimension(mm)	Cut Angle	End Face	X Face
LNO9315	3.0*3.0*15.0	Z-cut	AR/AR@1064nm	Au Electrodes
LNO9415	4.0*4.0*15.0	Z-cut	AR/AR@1064nm	Au Electrodes
LNO9625	6.0*6.0*25.0	Z-cut	AR/AR@1064nm	Au Electrodes
LNO9925	9.0*9.0*25.0	Z-cut	AR/AR@1064nm	Au Electrodes

Lithium Tantalate Crystal

$LiTaO_3$ crystal is also widely used as electro-optic modulator, with NLO and E-O properties similar to those of $LiNbO_3$ but higher damage threshold (>500 MW/cm^2 for ns pulsed).

Birefringent Crystal

YVO_4

The yttrium orthovanadate (YVO_4) is a positive uniaxial crystal grown with Czochralski method. It has good mechanical and physical properties and is ideal for optical polarizing components due to its wide transparency range and large birefringence. It is an excellent synthetic substitute for Calcite ($CaCO_3$) and Rutile (TiO_2) crystals in fiber optical applications such as isolators, circulators, beam displacers, Glan polarizers and other polarizing optics.

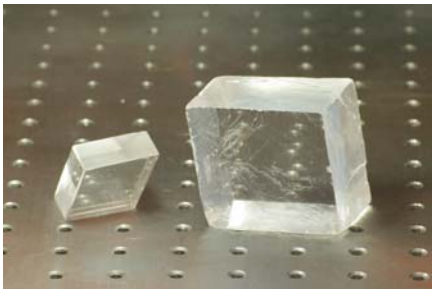
Capabilities

Dimension Tolerance	(W±0.1mm) x (H±0.1mm) x (L±0.2mm)
Optical Axis Orientation	±0.5°
Surface Flatness	λ/4@633nm
Surface Quality Better than	20/10 Scratch and Dig
Parallelism	<15 arc seconds
Perpendicularity	<10 arc minutes
Clear Aperture	>90% Central
AR-Coating	Per Your Request

Calcite

Calcite is a negative uniaxial crystal that has high birefringence, wide spectral transmission and availability in reasonably sized rhombs.

Although is a fairly soft crystal and is easily scratched, it is ideal material used as visible and near IR polarizers, such as Glan Thompson, and Glan Taylor Glan laser.

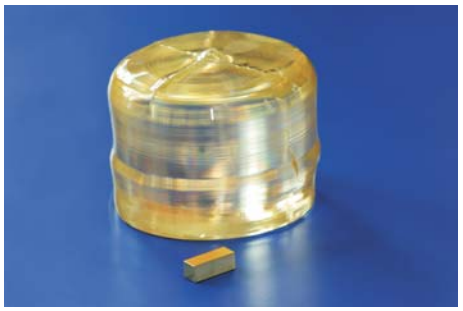


Capabilities

Dimension Tolerance	±0.1mm
Optical Axis Orientation	±0.5deg
Wavefront Distortion	<λ/2@633nm
Surface Flatness	<λ/4@633nm
Surface Quality	20/10 Scratch and Dig
Parallelism	<15 arc seconds
Perpendicularity	<10 arc minutes
Clear Aperture	>90%
AR-Coating	Per your Request

$LiNbO_3$

Lithium Niobate ($LiNbO_3$) is widely used in fiber communication devices as Birefringent crystal. It has good mechanical and physical properties and is ideal for optical polarizing components due to its wide transparency range and low cost. It is an excellent material in fiber communication applications such as isolators, circulators, beam displacers, and other polarizing optics.



Capabilities

Dimensional Tolerance	±0.1mm
Angle Tolerance	±0.5deg
Wavefront Distortion	<λ/4@633nm
Surface Flatness	<λ/8@633nm
Surface Quality	20/10 Scratch and Dig
Parallelism	<20 arc seconds
Perpendicularity	<5 arc minutes
Clear Aperture	>90%
AR-Coating	Per your Request

Iron Doped Lithium Niobate Crystal

Fe:$LiNbO_3$ crystal is widely used photo refractive material with large electro-optic coefficients, high photo refractive sensitivity and high diffraction efficiency. Due to these features, Fe:$LiNbO_3$ crystals are mostly used for memory, optical storage, information processing and holography applications. The iron level we can offer is from 0.005mol% to 0.1mol%.

Magnesium Oxide Doped Lithium Niobate Crystal

Compared with $LiNbO_3$ crystal, MgO:$LiNbO_3$ crystal exhibits its particular advantages for NCPM frequency doubling (SHG) of Nd:Lasers, mixing (SFG) and optical parametric oscillators (OPOs). MgO:$LiNbO_3$ is also a good crystal for optical parametric oscillators (OPOs) and amplifiers (OPAs), quasi-phase-matched doublers and integrated waveguide. MgO:$LiNbO_3$ has similar effective nonlinear coefficients to pure $LiNbO_3$. Its Sellmeier equations (for MgO dopant 7 mol%) are:

$$no^2=4.8762+0.11554/(\lambda^2 - 0.04674) - 0.033119\lambda^2$$

$$ne^2=4.5469+0.094779/(\lambda^2 - 0.04439) - 0.026721\lambda^2$$

Lithium Tantalate Crystal

$LiTaO_3$ crystal is also widely used as electro-optic modulator, with NLO and E-O properties similar to those of $LiNbO_3$ but higher damage threshold (>500 MW/cm^2 for ns pulsed).

a-BBO

High temperature form BBO (α-BaB_2O_4) is an excellent negative uni-axial birefringent crystal. It has large birefringence coefficient and good transmission over a broad range, from 189nm to 3500nm. Unlike ß-BBO, α-BBO is not useful for NLO application due to the centric symmetry with its crystal structure.

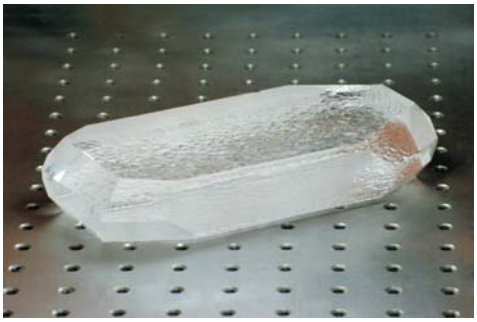
A-BBO is excellent crystal in Glan Taylor, Glan Laser and Glan Thompson polarizer as well as walk-off beamsplitters, especially for high power and UV polarizers. This is due to their unique UV transparency, good mechanical properties and high damage threshold. Union Optic manufactures many Glan polarizers and beam displacers from high quality α-BBO crystals for UV and high power operations.

Capabilities

Dimension Tolerance	±0.1mm
Optical Axis Orientation	±0.5deg
Wavefront Distortion	<λ/2@633nm
Surface Flatness	<λ/4@633nm
Surface Quality	20/10 Scratch and Dig
Parallelism	<15 arc seconds
Beam Deviation	<3 arc minutes
Clear Aperture	>90%
AR-Coating	Per your Request

Quartz

Single Synthetic Crystal Quartz is grown by hydrothermal method in autoclaves. It has trigonal crystal structure with right-handed or left-handed modification. Quartz crystals have low stress birefringence and high refractive index homogeneity. The optical transmission range of crystal quartz is 0.2-2.5microns. Due to its piezoelectric properties, low thermal expansion, good mechanical parameters and excellent optical characteristics, crystal quartz is widely used in electronics, precision and laser optics, fiber communications, X-ray optics, pressure sensors and etc.

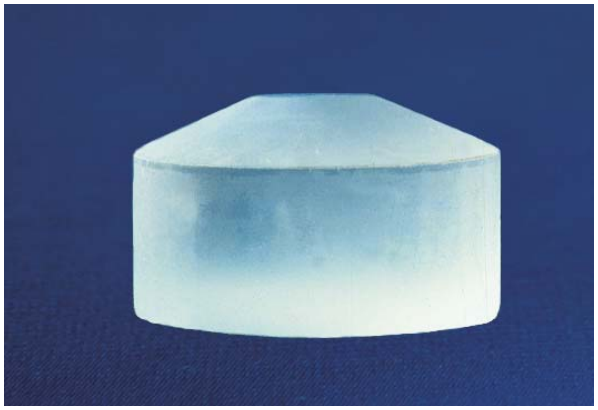


Capabilities

Dimension Tolerance	±0.1mm
Surface Quality	20/10 Scratch and Dig
Parallelism	Up to 1 arc second
Optical Axis Orientation	±0.5°
Flatness	<λ/8@633nm
Transmitted Wavefront Distortion	<λ/10@633nm
Clear Aperture	>90%
Coating	Per your Request

MgF_2

Magnesium Fluoride (MgF_2) is good birefringent crystal with good transmission over 120-7000nm. It is a hard material which is resistant to thermal and mechanical shock and can be worked according to the highest standards. MgF_2 single crystals is a positive birefringent crystal and widely used for Optical prisms, lenses, windows and other optical components.



Capabilities

Dimension Tolerance	±0.1mm
Surface Quality	20/10 Scratch and Dig
Parallelism	<1 arc minute
Optical Axis Orientation	±0.5°
Flatness	λ/4@633nm
Transmitted Wavefront Distortion	λ/4@633nm
Clear Aperture	>90%
AR Coating	Per your Request