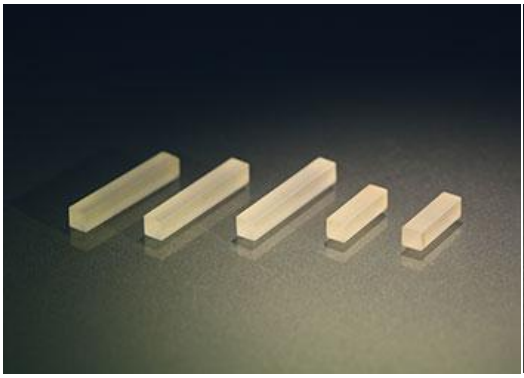
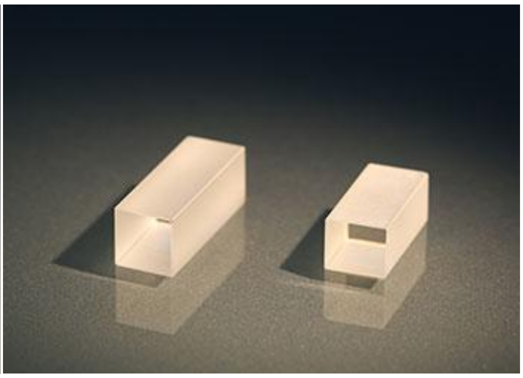
LBO Crystals - Lithium Triborate Crystals

Lithium Tri-borate or **LBO crystals** (LiB3O5) is one of the most useful nonlinear optical material not just for its relatively large conversion coefficient - 3x that of KDP, but also for its excellent physical properties. LBO crystal has broad optical transparency range from 160 to 2600nm. It excels in high power SHG with minimal thermal lensing as compared to KTP. Its large acceptance angle paired with small walk-off angle which reduces the beam quality requirement for source lasers.
LBO is widely used for SHG and THG of Nd:YAG, Nd:YLF, Nd:YVO4 and ultra-fast Ti:sapphire lasers. OPOs(Optical Parametric Oscillators) and OPAs(Optical Parametric Amplifier).

Features

- Broad transparency range from 160nm to 2600nm (SHG range from 550nm to 2600nm).
- Type I and type II non-critical phase-matching (NCPM) over a wide wavelength range.
- Relatively large effective SHG coefficient (about three times larger than that of KDP).
- High damage threshold (18.9 GW/cm2 for a 1.3ns laser at 1054nm).
- Wide acceptance angle and small walk-off.
- High optical quality (homogeneity Dn≈ 10-6/cm) and free of inclusion.

Following AR-coatings are available:

- Dual-band AR-coating of LBO for SHG of Nd:YAG lasers:
  Low reflectance(< 0.1% at 1064nm and < 0.25% at 532nm);
  High damage threshold(> 500 MW/cm2 at both wavelengths);
  Long durability.
- Broad Band AR-coating for frequency doubling Ti:Sapphire laser.
- Other coatings are available upon request.

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Table 1. Chemical and Structural properties

Chemical and Structure properties	
Crystal Structure	Orthorhombic, Space group Pna21, Point group mm2
Lattice Parameter	a=8.4473Å, b=7.3788Å , c=5.1395Å , Z=2
Melting Point	About 834℃
Mohs Hardness	6
Density	2.47 g/cm^3
Thermal Conductivity	3.5W/m/K
Thermal Expansion Coefficient	ax=10.8x10^{-5}/K, ay= -8.8x10^{-5}/K, az=3.4x10^{-5}/K

Table 2. Optical and Nonlinear Optical Properties

Optical and Nonlinear Optical Properties	
Transparency Range	160-2600nm
SHG Phase Matchable Range	551 ~ 2600nm (Type I) 790-2150nm (Type II)
Therm-optic Coefficient (°C, l in μm)	dnx/dT=-9.3X10^{-6} dny/dT=-13.6X10^{-6} dnz/dT=(-6.3-2.1l)X10^{-6}
Absorption Coefficient	<0.1%/cm at 1064nm <0.3%/cm at 532nm
Angle Acceptance	6.54mrad-cm (φ, Type I,1064 SHG) 15.27mrad-cm (q, Type II,1064 SHG)
Temperature Acceptance	4.7°C-cm (Type I, 1064 SHG) 7.5°C-cm (Type II,1064 SHG)
Spectral Acceptance	1.0nm-cm (Type I, 1064 SHG) 1.3nm-cm (Type II,1064 SHG)
Walk-off Angle	0.60° (Type I 1064 SHG) 0.12° (Type II 1064 SHG)
NLO Coefficient	deff(I)=d32cosφ (Type I in XY plane) deff(I)=d31cos^{2}θ+d32sin^{2}θ (Type I in XZ plane) deff(II)=d31cosθ (Type II in YZ plane) deff(II)=d31cos^{2}θ+d32sin^{2}θ (Type II in XZ plane)
Non-vanished NLO susceptibilities	d31=1.05 ± 0.09 pm/V d32= -0.98 ± 0.09 pm/V d33=0.05 ± 0.006 pm/V
Sellmeier Equations (λ in μm)	$n_x^2=2.454140+0.011249/(\lambda^2-0.011350)-0.014591\lambda^2-6.60\times10^{-5}\lambda^4$ $n_y^2=2.539070+0.012711/(\lambda^2-0.012523)-0.018540\lambda^2+2.0\times10^{-4}\lambda^4$ $n_z^2=2.586179+0.013099/(\lambda^2-0.011893)-0.017968\lambda^2-2.26\times10^{-4}\lambda^4$

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SPECIFICATIONS

Specifications	
Transmitting wavefront distortion	less than l/8 @ 633nm
Dimension tolerance	(W± 0.1 mm) x (H± 0.1 mm) x (L + 0.2 mm/-0.1 mm)
Clear aperture	central 80% diameter
No visible scattering paths or centers when inspected by a 30 mW green laser	
Flatness	l/8 @ 633nm
Surface Quality	10/5 Scratch/Dig to MIL-O-13830A
Parallelism	better than 20 arc seconds
Perpendicularity	15 arc minutes
Angle tolerance	Dq <±0.5°, Df <± 0.5°
Damage threshold: 15 GW/cm^2 for a TEM00 mode, 1.3 ns, 1 Hz laser at 1.064 mm 1 GW/cm^2 for a cw, mode-locked laser at 1064nm	
Quality warranty period	one year

Application Notes

- High power Nd:YAG and Nd:YLF lasers for R&D and military applications
- Ti:Sapphire, Alexandrite and Cr:LiSAF lasers.
- Medical and industrial Nd:YAG lasers.
- Diode laser pumped Nd:YVO4, Nd:YAG and Nd:YLF lasers.
- Frequency-tripling (THG) of Nd:YAG and Nd:YLF lasers.
- Optical parametric amplifiers (OPA) and oscillators (OPO) pumped by Excimer lasers and harmonics of Nd:YAG lasers.
- Frequency doubling (SHG) and tripling (THG) of high power Nd:YAP laser at 1340nm.

LBO crystal has broad optical transparency range from 160 to 2600nm. It excels in high power SHG with minimal thermal lensing as compared to KTP. Its large acceptance angle paired with small walk-off angle which reduces the beam quality requirement for source lasers. LBO also allows temperature controllable type I non-critical phase-matching(NCPM) for 1000 – 1300nm and type II NCPM for 800 to 1100nm at room temperature. With a high optical homogeneity (?n ~10-6), the material is grown virtually inclusion free. With a damage threshold of up to 45 GW/cm2 at 1064nm, it is again the material of choice for high power applications.

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