LBO (LiB3O5) Nonlinear Crystal for High-Power SHG and THG, 160–2600 nm

Model WQ-NLC-LBO · waveqvanta.com/products/lbo-lithium-triborate-crystal

Lithium triborate (LiB3O5, LBO) is an orthorhombic nonlinear crystal widely used for second harmonic generation of high-power 1064 nm lasers and for sum-frequency generation to 355 nm. It transmits from 160 nm to 2600 nm, supports Type I and Type II phase matching including non-critical phase matching (NCPM), and combines a high damage threshold with wide acceptance angle and small walk-off. LBO is also used in OPOs and OPAs pumped by the harmonics of Nd:YAG lasers or by 308 nm excimer lasers.



Key features

- Transparency range 160–2600 nm
- Effective SHG coefficient about 3 times that of KDP
- Optical homogeneity δn ≈ 10^{-6} /cm, free of inclusions
- Damage threshold above 10 GW/cm^2 at 1064 nm, 10 ns, 10 Hz (polished, uncoated)
- Small walk-off: 0.60° (Type I) and 0.12° (Type II) for 1064 nm SHG
- Wide angular acceptance: 6.54 mrad·cm (Type I) and 15.27 mrad·cm (Type II) for 1064 nm SHG
- Type I and Type II NCPM over a wide wavelength range, with spectral NCPM near 1300 nm
- Low susceptibility to moisture; dry conditions are recommended for use and storage

Specifications

Chemical Formula	LiB3O5
Crystal Structure	Orthorhombic, space group Pna21, point group mm2
Lattice Parameters	a = 8.4473 Å, b = 7.3788 Å, c = 5.1395 Å, Z = 2
Melting Point	About 834 °C
Mohs Hardness	6
Density	2.47 g/cm^3
Thermal Expansion Coefficients	αx = 10.8 × 10^{-5} /K, αy = −8.8 × 10^{-5} /K, αz = 3.4 × 10^{-5} /K
Thermal Conductivity	3.5 W/m/K
Transparency Range	160–2600 nm
SHG Phase-Matching Range	551–2600 nm (Type I); 790–2150 nm (Type II)
Thermo-Optic Coefficients (λ in μm)	dnx/dT = −9.3 × 10^{-6} /°C; dny/dT = −13.6 × 10^{-6} /°C; dnz/dT = (−6.3 − 2.1λ) × 10^{-6} /°C
Absorption Coefficients	< 0.1%/cm at 1064 nm; < 0.3%/cm at 532 nm
Angular Acceptance	6.54 mrad·cm (φ, Type I, 1064 nm SHG); 15.27 mrad·cm (θ, Type II, 1064 nm SHG)
Temperature Acceptance	4.7 °C·cm (Type I, 1064 nm SHG); 7.5 °C·cm (Type II, 1064 nm SHG)
Spectral Acceptance	1.0 nm·cm (Type I, 1064 nm SHG); 1.3 nm·cm (Type II, 1064 nm SHG)
Walk-off Angle	0.60° (Type I, 1064 nm SHG); 0.12° (Type II, 1064 nm SHG)
Effective SHG Coefficient	About 3 × KDP
Optical Homogeneity	δn ≈ 10^{-6} /cm

Dimension Tolerance	(W ± 0.1 mm) × (H ± 0.1 mm) × (L +0.5/−0.1 mm) for L ≥ 2.5 mm; (W ± 0.1 mm) × (H ± 0.1 mm) × (L ± 0.1 mm) for L < 2.5 mm
Clear Aperture	Central 90% of the diameter; no visible scattering paths or centers under 50 mW green laser inspection
Flatness	< λ/8 @ 633 nm
Transmitted Wavefront Distortion	< λ/8 @ 633 nm
Scratch/Dig	10/5 per MIL-PRF-13830B
Parallelism	Better than 20 arcsec
Perpendicularity	≤ 5 arcmin
Chamfer / Chip	≤ 0.2 mm × 45° / ≤ 0.1 mm
Angle Tolerance	Δθ ≤ 0.25°, Δφ ≤ 0.25°
Damage Threshold	> 10 GW/cm^2 at 1064 nm, TEM00, 10 ns, 10 Hz (polished only); > 1 GW/cm^2 at 1064 nm (AR-coated); > 0.5 GW/cm^2 at 532 nm (AR-coated)

Standard sizes

Size	Cut / orientation	Surface / coating	Mount
3 × 3 × 30 mm	θ = 90°, φ = 0°	AR/AR @ 1530–1580 nm + 765–790 nm	Unmounted
5 × 5 × 5 mm	θ = 90°, φ = 12.9°, Type I	AR/AR @ 1040 + 520 nm	Unmounted
5 × 5 × 3 mm	θ = 90°, φ = 14.6°, Type I	AR/AR @ 1014.4 + 507.4 nm	Unmounted
5 × 5 × 5 mm	θ = 90°, φ = 14.6°, Type I	AR/AR @ 1014.4 + 507.4 nm	Unmounted

Typical applications

- SHG of high-power pulsed and CW Nd:YAG and Nd:YLF lasers
- Third harmonic generation (SFG) of Nd:YAG lasers to 355 nm
- Frequency doubling of Ti:sapphire lasers in the 700–900 nm range
- OPOs and OPAs pumped at 532 nm, 355 nm or 308 nm, including temperature-tuned NCPM designs
- Sum-frequency generation into the VUV (187.7 nm reported)