Nonlinear Crystals

LBO – LITHIUM TRIBORATE

LBO is well suited for various nonlinear optical applications:
❯ frequency doubling and tripling of high peak power pulsed Nd doped, Ti:Sapphire and Dye lasers
❯ optical parametric oscillators (OPO) of both Type 1 and Type 2 phase-matching
❯ non-critical phase-matching for frequency conversion of CW and quasi-CW radiation.

FEATURES
❯ Wide transparency region
❯ Broad Type 1 and Type 2
❯ Non-critical phase-matching (NCPM) range
❯ Small walk-off angle
❯ High damage threshold
❯ Wide acceptance angle
❯ High optical homogeneity

STANDARD SPECIFICATIONS

- Flatness: \( \lambda/8 \) at 633 nm
- Parallelism: < 20 arcsec
- Surface quality: 10 – 5 scratch & dig (MIL-PRF-13830B)
- Perpendicularity: < 5 arcmin
- Angle tolerance: < 30 arcmin
- Aperture tolerance: ± 0.1 mm
- Clear aperture: 90% of full aperture

WE OFFER:
❯ Crystals length up to 90 mm and aperture up to 60 x 60 mm
❯ AR, BBAR, P-coatings
❯ Different mounting and repolishing services

STANDARD CRYSTALS LIST

<table>
<thead>
<tr>
<th>Size, mm</th>
<th>( \theta ), deg</th>
<th>( \phi ), deg</th>
<th>Coating</th>
<th>Application</th>
<th>Catalogue number</th>
<th>Price, EUR</th>
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<tr>
<td>3x3x10</td>
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<td>SHG @ 1064 nm</td>
<td>LBO-401</td>
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**PHYSICAL AND OPTICAL PROPERTIES**

**Chemical formula**: LiB$_3$O$_5$

**Crystal structure**: orthorhombic, mm2

**Optical symmetry**: Negative biaxial

**Space group**: Pna2$_1$

**Density**: 2.47 g/cm$^3$

**Mohs hardness**: 6

**Optical homogeneity**: $2\eta = 10^{-6}$ cm$^{-1}$

**Transparency region at "0" transmittance level**: 155 – 3200 nm

**Linear absorption coefficient at 1064 nm**: $< 0.01$ % cm$^{-1}$

**Refractive indices**:

<table>
<thead>
<tr>
<th>Wavelength (nm)</th>
<th>$n_x$</th>
<th>$n_y$</th>
<th>$n_z$</th>
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<td>532</td>
<td>1.5785</td>
<td>1.6065</td>
<td>1.6212</td>
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<td>1064</td>
<td>1.5656</td>
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<td>355</td>
<td>1.5971</td>
<td>1.6275</td>
<td>1.6430</td>
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**Sellmeier equations** ($\lambda$, µm):

\[
n_x^2 = 2.4542 + \frac{0.01125}{(\lambda^2 - 0.01135)} - 0.01388 \lambda^2
\]

\[
n_y^2 = 2.5390 + \frac{0.01277}{(\lambda^2 - 0.01189)} - 0.01849 \lambda^2 + 4.3025 \times 10^{-5} \lambda^4 - 2.9131 \times 10^{-5} \lambda^6
\]

\[
n_z^2 = 2.5865 + 0.0131 \frac{1}{\lambda^2 - 0.01223} - 0.01862 \lambda^2 + 4.5778 \times 10^{-5} \lambda^4 - 3.2526 \times 10^{-5} \lambda^6
\]

**Type 1 SHG phase matching range**: 554 – 2600 nm

**Type 2 SHG phase matching range**: 790 – 2150 nm

**NCPM SHG temperature dependence**:

**Type 1 range 950 – 1300 nm**

\[T_1 = -1893.3 \lambda^4 + 8886.6 \lambda^3 - 13019.8 \lambda^2 + 5401.5 \lambda + 863.9\]

**Type 1 range 1300 – 1800 nm**

\[T_2 = 878.1 \lambda^4 - 6954.5 \lambda^3 + 20734.2 \lambda^2 - 26378 \lambda + 12020\]

**Type 2 range 1100 – 1500 nm**

\[T_3 = -21630.6 \lambda^4 + 112251 \lambda^3 - 220460 \lambda^2 + 194153 \lambda - 64614.5\]

**NCPM SHG temperature at 1064 nm**

- Type 1 temperature 149 °C
- Type 2 temperature 43 °C

**Walk-off angle**: 7 mrad (Type 1 SHG 1064 nm)

**Thermal acceptance**: 6.4 K×cm (Type 1 SHG 1064 nm)

**Angular acceptance**: 6.5 mrad×cm (Type 1 SHG 1064 nm)

**Expansion coefficients**:

- $\alpha_x = 10.8 \times 10^{-5}$ K$^{-1}$
- $\alpha_y = -8.8 \times 10^{-5}$ K$^{-1}$
- $\alpha_z = 3.4 \times 10^{-5}$ K$^{-1}$

**Nonlinearity coefficients**:

- $d_{31} = -(0.98\pm0.09)$ pm/V
- $d_{32} = (1.05\pm0.09)$ pm/V
- $d_{33} = (0.05\pm0.006)$ pm/V

**Effective nonlinearity**:

- XY plane $d_{yoz} = d_{32} \cos \varphi$
- YZ plane $d_{zox} = d_{31} \cos \theta$

**Laser induced damage threshold (LIDT)**: $>5$ J/cm$^2$ (>500 MW/cm$^2$), 1064 nm, 10 ns, 10 Hz

**Related Products**

**LBO crystals for SHG of Yb:KGW/KYW laser frequency conversion.** See page 4.42

**Crystal Oven TC2**

[See page 2.28]

149 °C temperature is required to achieve Non-Critical Phase Matching (NCPM) in LBO at type 1 SHG of 1064 nm application. **TC2 oven** is specially designed for this purpose (see technical specifications, p. 2.28).

**Heatpoint Crystal Oven**

[See page 2.29]

**Heatpoint** is a compact round oven designed for heating (30 – 80 °C) of humidity sensitive nonlinear crystals. It is used to prevent moisture condensation on crystal faces or for thermostabilization of the crystals.

Please contact EKSMA OPTICS for further information or nonstandard specifications.