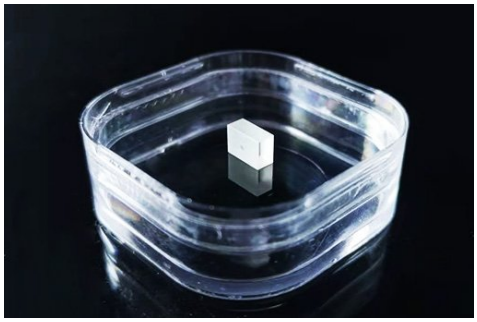
BBO (β-BaB2O4) Nonlinear Crystal for UV Harmonic Generation, 190–3500 nm

Model WQ-NLC-BBO · waveqvanta.com/products/bbo-beta-barium-borate-crystal

Beta-barium borate (β-BaB2O4, BBO) is a negative uniaxial nonlinear crystal in which both Type I and Type II phase matching are reached by angle tuning. It transmits from 190 nm to 3500 nm and is used for the second, third, fourth and fifth harmonics of Nd:YAG lasers, including 5HG at 213 nm, as well as for frequency doubling of ultrafast lasers. Its electro-optic coefficient also makes it suitable for Pockels cells and EO Q-switches.



Key features

- Transparency range 190–3500 nm
- SHG phase-matching range 409.6–3500 nm (Type I) and 525–3500 nm (Type II)
- Effective SHG coefficient about 6 times that of KDP
- Reported Nd:YAG conversion efficiencies above 70% (SHG), 60% (THG) and 50% (4HG)
- Optical homogeneity $\delta n \approx 10^{-6}$ /cm
- Temperature acceptance 55 °C·cm for 1064 nm SHG
- Damage threshold above 1 GW/cm^2 at 1064 nm, 10 ns, 10 Hz (polished, uncoated)
- Slightly hygroscopic and relatively soft (Mohs 4): use and store dry, and protect polished faces

Specifications

Chemical Formula	β-BaB2O4
Crystal Structure	Trigonal, space group R3c
Lattice Parameters	a = b = 12.532 Å, c = 12.717 Å, Z = 6
Melting Point	About 1095 °C
Mohs Hardness	4
Density	3.85 g/cm^3
Thermal Expansion Coefficients	$\alpha 11 = 4 \times 10^{-6}$ /K; $\alpha 33 = 36 \times 10^{-6}$ /K
Thermal Conductivity	⊥c: 1.2 W/m/K; ∥c: 1.6 W/m/K
Transparency Range	190–3500 nm
SHG Phase-Matching Range	409.6–3500 nm (Type I); 525–3500 nm (Type II)
Thermo-Optic Coefficients	$dno/dT = -16.6 \times 10^{-6}$ /°C; $dne/dT = -9.3 \times 10^{-6}$ /°C
Absorption Coefficients	< 0.1%/cm at 1064 nm; < 1%/cm at 532 nm
Angular Acceptance	0.8 mrad·cm (θ, Type I, 1064 nm SHG); 1.27 mrad·cm (θ, Type II, 1064 nm SHG)
Temperature Acceptance	55 °C·cm
Spectral Acceptance	1.1 nm·cm
Walk-off Angle	2.7° (Type I, 1064 nm SHG); 3.2° (Type II, 1064 nm SHG)
Effective Nonlinear Coefficient	$d_{eff}(I) = d31 \sin\theta + (d11 \cos 3\varphi - d22 \sin 3\varphi) \cos\theta$; $d_{eff}(II) = (d11 \sin 3\varphi + d22 \cos 3\varphi) \cos^2\theta$
Nonlinear Coefficients	d11 = 5.8 × d36(KDP); d31 = 0.05 × d11; d22 < 0.05 × d11
Electro-Optic Coefficient / Half-Wave Voltage	γ22 = 2.7 pm/V; 7 kV at 1064 nm (3 × 3 × 20 mm^3)

Values are typical and subject to change. Custom sizes, cut angles and coatings are available on request.

Optical Homogeneity	$\delta n \approx 10^{-6}$ /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 / Transmitted Wavefront Distortion	< λ/8 @ 633 nm
Scratch/Dig	10/5 per MIL-PRF-13830B
Parallelism / Perpendicularity	≤ 20 arcsec / ≤ 5 arcmin
Chamfer / Chip	≤ 0.2 mm × 45° / ≤ 0.1 mm
Angle Tolerance	≤ 0.25°
Damage Threshold	> 1 GW/cm^2 at 1064 nm, TEM00, 10 ns, 10 Hz (polished only); > 0.5 GW/cm^2 at 1064 nm (AR-coated); > 0.3 GW/cm^2 at 532 nm (AR-coated)

Dispersion (Sellmeier) equations

$no^2 = 2.7359 + 0.01878 / (\lambda^2 - 0.01822) - 0.01354\ \lambda^2$ (λ in μm)
$ne^2 = 2.3753 + 0.01224 / (\lambda^2 - 0.01667) - 0.01516\ \lambda^2$ (λ in μm)

Standard sizes

Size	Cut / orientation	Surface / coating	Mount
10 × 10 × (0.01 + 1) mm	θ = 37°	Blank	Mounted
5 × 5 × 0.07 mm	θ = 29.2°	Polished, uncoated	Mounted
10 × 10 × 0.1 mm	θ = 29.2°	Polished, uncoated	—
10 × 10 × 0.5 mm	θ = 29.2°	P-coated @ 800 + 400 nm	Mounted
5 × 5 × 1 mm	θ = 51.2°, Type I	S1/S2: P-coated @ 350 nm	—
5 × 5 × 3 mm	θ = 51.2°, Type I	S1/S2: P-coated @ 350 nm	—
5 × 5 × 5 mm	θ = 51.2°, Type I	S1/S2: P-coated @ 350 nm	—
Ø10 × 0.1 mm	θ = 29.2°	P-coated @ 800 + 400 nm	Mounted
10 × 6 × 0.1 mm	θ = 29.2°	P-coated @ 800 + 400 nm	Mounted
10 × 3 × 0.1 mm	θ = 29.2°	P-coated @ 800 + 400 nm	Mounted
10 × 10 × 0.3 mm	θ = 29.2°	P-coated @ 800 + 400 nm	Mounted
10 × 10 × 1 mm	θ = 23.4°, Type I	S1/S2: P-coated @ 1030 + 515 nm	Mounted
Ø7 × 0.2 mm	θ = 29.2°	P-coated @ 800 + 400 nm	Mounted
Ø8 × 0.5 mm	θ = 28.8°, Type II	S1: P-coated @ 1400 nm; S2: P-coated @ 800 nm	Mounted
Ø8 × 0.5 mm	θ = 19.8°, Type I	S1: P-coated @ 1400 nm; S2: P-coated @ 800 nm	Mounted
Ø8 × 3 mm	θ = 19.8°, Type I	S1: P-coated @ 1400 nm; S2: P-coated @ 800 nm	Mounted

Typical applications

- Second, third and fourth harmonic generation of Nd:YAG lasers (532, 355 and 266 nm)
- Fifth harmonic generation of Nd:YAG lasers at 213 nm
- Intracavity SHG of high-power Q-switched Nd:YAG lasers
- Frequency doubling of ultrafast Ti:sapphire (800 nm) and Yb (1030 nm) lasers with thin crystals
- Electro-optic Pockels cells and Q-switches