

| | |
|-------------------|--------------------------------|
| Chemical Formula: | $\beta\text{-BaB}_2\text{O}_4$ |
| Crystal Symmetry: | trigonal |
| Optical Symmetry: | uniaxial negative |
| Class: | 3m |

BBO Single Crystals



As-grown BBO boule with finished crystals for EO and NLO applications

OVERVIEW

Barium borate (BBO) is a nonlinear optical crystal used in a wide variety of phasematching applications. Its properties also make it an ideal candidate material for transverse field Pockels cells. Inrad Optics grows BBO crystals using a proprietary top seeded flux growth method. This process has been refined and perfected over several decades at our New Jersey facility.

All crystal growth, orientation, fabrication, polishing, coating, and testing of BBO crystal components is done in-house to ensure complete traceability and satisfaction with every crystal we produce.

FEATURES

- Large effective nonlinear coefficients
- Broad phasematching range from 410 nm to 2100 nm
- Wide optical transmission range from 200 nm to 2100 nm
- High laser damage threshold
- Low thermo-optic coefficient

ADVANTAGES

- Second harmonic generation to generate wavelengths as short as 204.8 nm
- Shorter wavelengths can be generated by sum frequency mixing
- Fifth harmonic generation of Nd:YAG by mixing the fundamental and the fourth harmonic
- UV generation over a broad wavelength range by mixing the output of a Ti:sapphire laser
- Optical parametric amplification (OPA) of short pulses
- Optical parametric oscillators (OPOs) for producing wavelengths in the visible, near infrared, and the ultraviolet



BBO pockels cells

SIZES

Available crystal lengths range from 50 μm for extremely short pulse widths to about 25 mm for nanosecond OPO/OPA use. Aperture sizes can be as large as 20x20 mm. The optimum length is largely determined by the angular acceptance of the crystal for phasematching.

ORIENTATION

When submitting a request for a custom crystal, please specify whether the interaction is type I or II and the desired phase match angle, θ . Crystals are oriented in a double crystal x-ray spectrometer and are typically accurate to within 1 arcminute. The standard orientations listed in the table below are frequently requested type I cut angles and may be available for immediate shipment from inventory.

| BBO Standard Orientations | | | | |
|---------------------------|----------------|-----------|-------------------------|-------------|
| Designation | Angle θ | Operation | Input [nm] | Output [nm] |
| "0" | 68.5° | SHG | 418-464 | 209-232 |
| | | THG | (600-665) + (300-331) | 200-220 |
| "1" | 53.2° | SHG | 454-560 | 227-280 |
| | | THG | (651-800) + (325-400) | 217-266 |
| "2" | 37.4° | SHG | 542-820 | 271-410 |
| | | THG | (774-1165) + (387-582) | 258-388 |
| "A" | 78° | SHG | 410-433 | 205-216 |
| | | THG | (594-620) + (297-310) | 198-206 |
| "B" | 55° | SHG | 448-543 | 224-271 |
| | | THG | (642-775) + (321-358) | 214-258 |
| "C" | 65° | SHG | 423-480 | 211-240 |
| | | THG | (608-687) + (304-343) | 203-229 |
| "TSS" | 28.7° | SHG | 636-1000 | 318-500 |
| | | THG | (906-2100) + (453-1050) | 302-700 |
| "TST" | 44° | SHG | 496-675 | 248-337 |
| | | THG | (710-960) + (355-480) | 237-320 |
| "OPO1" | 36.6° | SHG | 549-844 | 275-422 |
| | | THG | (784-1200) + (392-600) | 262-400 |
| | | SFM | 1064 + (510-567) | 345-370 |
| "OPO2" | 57.5° | SHG | 440-525 | 220-262 |
| | | THG | (632-750) + (316-375) | 211-250 |
| "M1" | 50.2° | SFM | 1064 + (243-340) | 198-257 |
| "DGN" | 31° | SFM | 1064 + (380-980) | 280-510 |
| "IDLR" | 20° | SHG | 1380-1460 | 690-730 |
| "OPO3" | 30° | OPO | 355 | 410-2000 |
| "SHG" | 22.8° | SHG | 1064 | 532 |
| "THG" | 31.3° | THG | 1064 + 532 | 355 |
| "4HG" | 47.6° | 4HG | 532 | 266 |
| "_-" | 22° | SHG | 1550 | 775 |

FINISHING

Optical surfaces are typically polished to $< \lambda/10$ TWE and scratch-dig of 10/5 or better. Depending on application requirements, crystals are typically wedged by 30 arcseconds in the non-tuning direction or made parallel to < 5 seconds. Crystals are also available cut at Brewster's angle for use in high laser damage applications and where low insertion losses are required.



Brewster-cut BBO crystals with six-sided polish (two optical and four inspection polished faces)

COATINGS

All crystals are offered with a single layer MgF_2 protective AR coating to prevent damage to polished surfaces from ambient moisture. BBO is moderately hygroscopic, so unprotected polished surfaces are susceptible to fogging over in most laboratory situations. The protective coating also reduces fresnel losses from the polished surface, thus improving transmission for all wavelengths that are used. Custom coatings including dual-band AR are also available.