

BBO crystals

Main features

- Broad transparency range from 188 nm to 5,2 μm (reasonable transparency @3 μm - 5,2 μm for few tens μm thick crystals)
- Broad phase-matchable range for various second order nonlinear interactions over almost the entire transparency range
- Wide thermal acceptance bandwidth
- Highest nonlinearity of all UV nonlinear crystals
- High laser induced damage threshold
- Ultrathin crystals available for few optical cycle laser pulses
- Custom size, orientation and coatings are available upon request

Application examples

- Harmonic generation (up to fifth) of pulsed Nd-doped crystal based lasers
- Frequency doubling, tripling of pulsed Ti:Sapphire, Yb-doped, dye lasers
- Widely tunable type I and II OPO
- Characterization of ultrashort laser pulses by FROG, XFROG, SPIDER, dispersion scan, chirp scan methods

BBO crystal transparency ranges from 188 nm to 5,2 μm, which includes reasonable transparency from 3 μm - 5,2 μm for few tens μm thick crystals, while their phase-matchable range spans almost over the entire transparency range. Combined with other magnificent properties of BBO, it is favorable for numerous nonlinear parametric applications, e.g. harmonic generation of pulsed Yb-doped crystal based lasers and frequency doubling, tripling of Ti:Sapphire lasers, widely tunable type I and II OPO. It is worth to mention that BBO crystals have the highest nonlinearity in the UV range out of all common nonlinear crystals.

Standard specifications

BBO CRYSTALS	
Orientation accuracy	<30 arcmin
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Parallelism error	<20 arcsec
Perpendicularity error	<5 arcmin
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 S-D
Wavefront distortion	<λ/8@632,8 nm
Coatings	Low dispersion protective coatings or antireflective coatings on both sides
Laser induced damage threshold	>500 MW/cm ² @1064 nm, 10 ns
UVFS support	Crystals with <0,1 mm thickness are optically contacted to 0,5-1 mm UVFS support
Mount	Mounted in Ø25,4 mm black or natural aluminum mount

Properties

PHYSICAL AND OPTICAL PROPERTIES	
Chemical formula	β-BaB ₂ O ₆
Crystal structure	Rhombohedral, 3m
Lattice parameters	a=12,532 Å, c=12,717 Å
Optical symmetry	Negative uniaxial (n _e >n _o)
Density	3,85 g/cm ³
Mohs hardness	4-4,5
Transparency range	188 nm - 5,2 μm, reasonable from 3 μm to 5,2 μm for thin crystals (few tens of μm)
Sellmeier equations @188 nm - 5,2 μm range (λ in μm)	$n_o^2 = 1 + 0,90291 \lambda^2 / (\lambda^2 - 0,003926) + 0,83155 \lambda^2 / (\lambda^2 - 0,018786) + 0,76536 \lambda^2 / (\lambda^2 - 60,01);$ $n_e^2 = 1 + 1,151075 \lambda^2 / (\lambda^2 - 0,007142) + 0,21803 \lambda^2 / (\lambda^2 - 0,02259) + 0,656 \lambda^2 / (\lambda^2 - 263)$
Refractive indices	n _o = 1,6551, n _e = 1,5426 @1064 nm

Guidance

Optogama provide guidance and theoretical calculations for particular BBO applications. Contact us and we will help you to configure your crystal.

Standard products

FACE DIMENSIONS	LENGTH	THETA	PHI	COATINGS	APPLICATION	SKU
6 x 6 mm	0,1 mm	50°	90°	P/P@515/257 nm	SHG@515 nm, 50 fs, type I	15808
	0,15 mm	50°	90°	P/P@515/257 nm	SHG@515 nm, 100 fs, type I	15809
	0,3 mm	50°	90°	P/P@515/257 nm	SHG@515 nm, 200 fs, type I	15810
	0,05 mm	29,2°	90°	P/P@400-800 nm	SHG@800 nm, 10 fs, type I	15811
	0,1 mm	29,2°	90°	P/P@400-800 nm	SHG@800 nm, 20 fs, type I	6399
	0,2 mm	29,2°	90°	P/P@400-800 nm	SHG@800 nm, 50 fs, type I	15833
	0,5 mm	29,2°	90°	P/P@400-800 nm	SHG@800 nm, 100 fs, type I	6398
	1 mm	29,2°	90°	P/P@400-800 nm	SHG@800 nm, 200 fs, type I	6400
	0,5 mm	23,4°	90°	AR/AR@515+1030 nm	SHG@1030 nm, 50 fs, type I	9447
	1 mm	23,4°	90°	AR/AR@515+1030 nm	SHG@1030 nm, 100 fs, type I	9448
	1,5 mm	23,4°	90°	AR/AR@515+1030 nm	SHG@1030 nm, 150 fs, type I	9449
	2 mm	23,4°	90°	AR/AR@515+1030 nm	SHG@1030 nm, 200 fs, type I	10733
	0,01 mm	44,3°	90°	P/P@400-800/266 nm	THG@800 nm, 10 fs, type I	15834
	0,02 mm	44,3°	90°	P/P@400-800/266 nm	THG@800 nm, 20 fs, type I	15835
	0,05 mm	44,3°	90°	P/P@400-800/266 nm	THG@800 nm, 50 fs, type I	15836
	0,1 mm	44,3°	90°	P/P@400-800/266 nm	THG@800 nm, 100 fs, type I	9044
	0,2 mm	44,3°	90°	P/P@400-800/266 nm	THG@800 nm, 200 fs, type I	15837
	0,15 mm	32,5°	90°	AR/AR@515+1030/343 nm	THG@1030 nm, 50 fs, type I	9450
	0,25 mm	32,5°	90°	AR/AR@515+1030/343 nm	THG@1030 nm, 100 fs, type I	9451
	0,55 mm	32,5°	90°	AR/AR@515+1030/343 nm	THG@1030 nm, 200 fs, type I	9452

LBO crystals

Main features

- Broad transparency range from 155 nm to 3200 nm
- Absence of photochromic damage (gray-tracking)
- Highest damage threshold among common nonlinear crystals
- Small walk-off angle at room temperature, no walk-off at NCPM regime
- Wide acceptance angle
- Temperature tunable type I and II non-critical phase-matching
- Custom size, orientation and coatings are available upon

Application examples

- Sum-frequency generation of 532 nm and 1064 nm to produce 355 nm UV radiation
- Widely tunable OPOs in NIR range pumped by second harmonic of Nd-doped lasers
- Efficient second harmonic generation at 1064 nm without walk-off effect (NCPM, $t = 149^\circ\text{C}$)

Lithium Triborate (LiB₃O₅, LBO) crystals feature a broad transparency range, wide acceptance angle, small walk-off angle and the highest damage threshold among common nonlinear crystals. Most common applications include high-power near-infrared wavelength second harmonic generation, sum frequency generation to produce visible, ultraviolet laser light and visible, near-infrared widely tuned optical parametric oscillators.

Standard specifications

LBO CRYSTALS	
Orientation accuracy	<30 arcmin
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<20 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 S-D
Wavefront distortion	<λ/4@632,8 nm
Coatings	AR coatings on both sides
Laser induced damage threshold	>1 GW/cm ² @1064 nm, 10 ns
Mount	Unmounted

Properties

PHYSICAL AND OPTICAL PROPERTIES	
Chemical formula	LiB ₃ O ₅
Crystal structure	Orthorhombic, mm ²
Lattice parameters	a = 8,46 Å, b = 7,38 Å, c = 12,717 Å
Optical symmetry	Negative biaxial (2V _x = 109,2° @0,5321 μm)
Density	2,474 g/cm ³
Mohs hardness	6-7
Transparency range	155 nm - 3,2 μm @"0" transmittance level
Sellmeier equations @T = 293 K (λ in μm)	$n_x^2 = 2,4542 + 0,01125/(\lambda^2 - 0,01135) - 0,01388 \lambda^2$ $n_y^2 = 2,5390 + 0,01277/(\lambda^2 - 0,01189) - 0,01849 \lambda^2$ $+ 4,3025 \times 10^{-5} \lambda^4 - 2,9131 \times 10^{-5} \lambda^6$ $n_z^2 = 2,5865 + 0,0131/(\lambda^2 - 0,01223) - 0,01862 \lambda^2 + 4,5778 \times 10^{-5} \lambda^4 - 3,2526 \times 10^{-5} \lambda^6$
Refractive indices	$n_x = 1,5656$; $n_y = 1,5905$; $n_z = 1,6055$ @1064 nm

Guidance

Optogama provides guidance and theoretical calculations for particular LBO applications. Contact us and we will help you to configure your crystal.

Standard products

FACE DIMENSIONS	LENGTH	THETA	PHI	COATINGS	APPLICATION	SKU
3 x 3 mm	10 mm	90°	11,6°	AR/AR@532+1064 nm	SHG@1064 nm, type I	7203
	10 mm	42,2°	90°	AR/AR@532+1064/355 nm	THG@1064 nm, type II	7199
	10 mm	90°	0°	AR/AR@532+1064 nm	NCPM SHG@1064 nm, T = 149 °C	7209
	20 mm	90°	11,6°	AR/AR@532+1064 nm	SHG@1064 nm, type I	7202
	20 mm	42,2°	90°	AR/AR@532+1064/355 nm	THG@1064 nm, type II	9457
	20 mm	90°	0°	AR/AR@532+1064 nm	NCPM SHG@1064 nm, T = 149 °C	7210
5 x 5 mm	10 mm	90°	11,6°	AR/AR@532+1064 nm	SHG@1064 nm, type I	7207
	10 mm	42,2°	90°	AR/AR@532+1064/355 nm	THG@1064 nm, type II	7204
	20 mm	90°	11,6°	AR/AR@532+1064 nm	SHG@1064 nm, type I	7208
	20 mm	42,2°	90°	AR/AR@532+1064/355 nm	THG@1064 nm, type II	9459
6 x 6 mm	1 mm	90°	13,8°	AR/AR@515+1030 nm	SHG@1030 nm, type I	9458
	2 mm	90°	13,8°	AR/AR@515+1030 nm	SHG@1030 nm, type I	9460
	3 mm	90°	13,8°	AR/AR@515+1030 nm	SHG@1030 nm, type I	9461
	4 mm	90°	13,8°	AR/AR@515+1030 nm	SHG@1030 nm, type I	9462


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KTP crystals

Main features

- High nonlinearity
- Nonhygroscopic crystal
- Great mechanical stability
- Wide transparency range from 350 nm to 4,5 μm
- Broad angular and thermal acceptance
- Broad type I and II non-critical phase-matching range

Application examples

- Low and medium power frequency doubling of Nd-doped lasers
- KTP OPO and ZGP OPO tandem for mid-infrared generation

Potassium titanyl phosphate (KTiOPO₄, KTP) crystals are advantageous due to their high nonlinearity, great mechanical stability, high optical quality and transparency range of 350 nm - 4,5 μm. These features determine the wide application of KTP crystals as a nonlinear medium.

It is an excellent solution for frequency doubling applications of Nd-doped lasers, especially for low and medium power applications, both intra- and extra-cavity design.

Besides, these crystals can be used as a nonlinear OPO medium for IR generation up to 4 μm and used as a pump source for mid-IR nonlinear crystal based optical parametric oscillators, such as ZGP OPO. KTP is susceptible to photochromic damage (grey-tracking), which causes deterioration of nonlinear conversion efficiency. Optogama provide high grey track resistance (HGTR) KTP crystals as a solution, which significantly improves the grey-track resistance and overall performance. HGTR KTP crystals extend the use of KTP as a nonlinear medium to high-power applications.

Please request in case you need HGTR KTP crystals for your applications.

Standard specifications

KTP CRYSTALS	
Orientation accuracy	<30 arcmin
Clear aperture	>90%
Face dimensions tolerance	+0,0/-0,1 mm
Length tolerance	±0,1 mm
Parallelism error	<20 arcsec
Perpendicularity error	<5 arcmin
Protective chamfers	<0,1 mm at 45°
Surface quality	10-5 S-D
Wavefront distortion	<λ/8@632,8 nm
Coatings	AR(R<0,25%)532+1064 nm on both faces
Laser induced damage threshold	>500 MW/cm ² @1064 nm, 10 ns
Mount	Unmounted

Properties

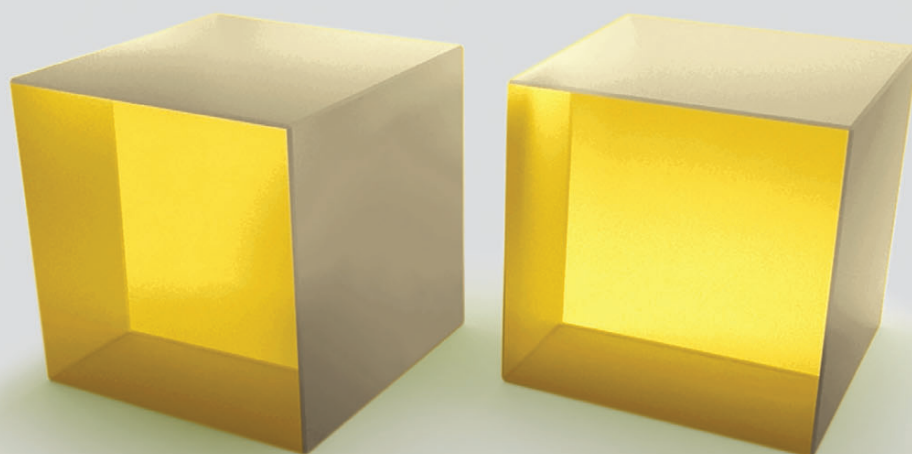
PHYSICAL AND OPTICAL PROPERTIES	
Chemical formula	KTiOPO ₄
Crystal structure	Orthorhombic, mm ²
Lattice parameters	a = 12,814 Å, b = 6,404 Å, c = 10,616 Å
Optical symmetry	Positive biaxial (2V _x = 37,4° @0,5461 μm)
Density	2,945 g/cm ³
Mohs hardness	5
Transparency range	350 nm - 4,5 μm @"0" transmittance level
Sellmeier equations (λ in μm)	$n_x^2 = 3,0067 + 0,0395/(\lambda^2 - 0,04251) - 0,01247 \lambda^2$; $n_y^2 = 3,0319 + 0,04152/(\lambda^2 - 0,04586) - 0,01337 \lambda^2$; $n_z^2 = 3,3134 + 0,05694/(\lambda^2 - 0,05941) - 0,016713 \lambda^2$
Refractive indices	n _x = 1,7404; n _y = 1,7479; n _z = 1,8296 @1064 nm

Guidance

Optogama provide guidance and theoretical calculations for particular KTP applications. Contact us and we will help you to configure your crystal.

Standard products

FACE DIMENSIONS	GRADE	LENGTH	THETA	PHI	COATINGS	APPLICATION	SKU
3 x 3 mm	Regular	5 mm	90°	23,5°	AR/AR@532+1064 nm	SHG@1064 nm, type II	7184
	HGTR	5 mm	90°	23,5°	AR/	SHG@1064 nm	36625
	HGTR	10 mm	90°	23,5°	AR/	SHG@1064 nm	36626
	Regular	10 mm	90°	23,5°	AR/AR@532+1064 nm	SHG@1064 nm, type II	7188
5 x 5 mm	Regular	5 mm	90°	23,5°	AR/AR@532+1064 nm	SHG@1064 nm, type II	7189
	HGTR	5 mm	90°	23,5°	AR/	SHG@1064 nm	36627
	HGTR	10 mm	90°	23,5°	AR/	SHG@1064 nm	36628
	Regular	10 mm	90°	23,5°	AR/AR@532+1064 nm	SHG@1064 nm, type II	7193
7 x 7 mm	Regular	5 mm	90°	23,5°	AR/AR@532+1064 nm	SHG@1064 nm, type II	7194
	HGTR	5 mm	90°	23,5°	AR/	SHG@1064 nm	36630
	HGTR	10 mm	90°	23,5°	AR/	SHG@1064 nm	36631
	Regular	10 mm	90°	23,5°	AR/AR@532+1064 nm	SHG@1064 nm, type II	7198



AgGaS₂ crystals

Main features

- Unique non-linear properties across the transmission range from 0,5 μm to 12 μm
- Low optical absorption and scattering
- Transparency at short wavelengths

Application examples

- Frequency mixing in the middle IR region up to $\sim 12 \mu\text{m}$
- Second harmonic generation and up-conversion for CO₂ lasers
- Tunable OPO for solid-state lasers

Silver Thiogallate (AgGaS₂, AGS) has been demonstrated as an efficient crystal for nonlinear parametric applications in the infrared spectral range. Its transparency region spans from 0,53 μm to 12 μm . AGS based optical parametric oscillators feature continuously tunable radiation over a wide range of wavelengths in the infrared spectral range. High transparency in the short wavelength range beginning at 550 nm is used in OPOs pumped by Nd:YAG laser.

Using 2050 nm pump laser, an optimally designed AgGaS₂ OPO is tunable from about 2.5 to 12.0 μm . The output range can be extended by the sum or difference frequency mixing (SFM/DFM). AGS crystal features high non-linear coefficient, high damage threshold, low optical absorption and scattering.

Standard specifications

AgGaS ₂ CRYSTALS	
Orientation accuracy	<30 arcmin
Clear aperture	>80%
Face dimensions tolerance	+0,0/-0,2 mm
Parallelism error	<30 arcsec
Perpendicularity error	<10 arcmin
Protective chamfers	<0,2 mm at 45°
Surface quality	60-40 S-D
Coatings	BBAR/BBAR@1,2-2,6 μm /2,6-11 μm
Mount	Unmounted

Properties

PHYSICAL AND OPTICAL PROPERTIES	
Chemical formula	AgGaS ₂
Crystal structure	Tetragonal, 42m
Lattice parameters	$a = 5,742 \text{ \AA}$, $c = 10,26 \text{ \AA}$
Optical symmetry	Negative uniaxial ($n_x > n_y$, $\lambda < 0,497 \mu\text{m}$ $n_x > n_y$)
Density	4,58 g/cm ³
Mohs hardness	3-3,5
Transparency range	0,47 - 13 μm @ "0" transmittance level
Sellmeier equations @ T = 293 K (λ in μm)	$n_x^2 = 5,79419 + 0,23114/(\lambda^2 - 0,06882) - 2,4534 \times 10^{-3} \lambda^2 + 3,1814 \times 10^{-7} \lambda^4 - 9,7051 \times 10^{-9} \lambda^6$; $n_y^2 = 5,54120 + 0,22041/(\lambda^2 - 0,09824) - 2,5240 \times 10^{-3} \lambda^2 + 3,6214 \times 10^{-7} \lambda^4 - 8,3605 \times 10^{-9} \lambda^6$
Refractive indices	$n_x = 2,3471$; $n_y = 2,2914$ @ 10,6321 μm
Thermal conductivity	1,4 (llc) Wm ⁻¹ K ⁻¹ , 1,5 (Lc) Wm ⁻¹ K ⁻¹

Guidance

Optogama provides guidance and theoretical calculations for particular AgGaS₂ applications. Contact us and we will help you to configure your crystal.

Standard products

FACE DIMENSIONS	LENGTH	THETA	PHI	COATINGS	APPLICATION	SKU
5 x 5 mm	1 mm	39°	45°	BBAR/BBAR@1,2-2,6/2,6-11 μm	DFG@1,2-2,6 μm , type I	7356
8 x 8 mm	1 mm	39°	45°	BBAR/BBAR@1,2-2,6/2,6-11 μm	DFG@1,2-2,6 μm , type I	7395
6 x 6 mm	2 mm	50°	0°	BBAR/BBAR@1,2-2,6/2,6-11 μm	DFG@1,2-2,6 μm , type II	7396
8 x 8 mm	2 mm	50°	0°	BBAR/BBAR@1,2-2,6/2,6-11 μm	DFG@1,2-2,6 μm , type II	7397

BSO crystals

Main features

- High electro-optic coefficient ($r_{41} = 5 \text{ pm/V}$)
- High phase-conjugation efficiency
- Available in large size elements or wafers up to 3"
- Customization available upon request

Application examples

- Spatial light modulators
- Optical switches
- Pockels readout optical memory (PROM) applications
- Optical waveguides

Bismuth silicon oxide ($\text{Bi}_{12}\text{SiO}_{20}$, BSO) crystals are highly efficient photoconductors with a low dark conductivity, that allows a build-up of large photo-induced space-charges. Tremendous photoconductivity and electro-optic properties make BSO crystals attractive in a range of applications: spatial light modulators, optical switches, phase conjugation mixers. BSO crystals are grown by modified Czochralski method and available in up to 3" diameter aperture size. Crystals can be supplied with ITO coatings on request.

Standard specifications

BSO CRYSTALS	
Clear aperture	85%
Face dimensions tolerance	+0.1/-0.25 mm
Thickness tolerance	±0.2 mm
Parallelism error	<30 arcsec
Protective chamfers	<0.3 mm at 45°
Surface quality	40-20 S-D
Wavefront distortion	<λ/4@632.8 nm
Coatings	Uncoated
Mount	Unmounted

Properties

MAIN PROPERTIES	
Chemical formula	$\text{Bi}_{12}\text{SiO}_{20}$
Crystal structure	Cubic, point group 23
Lattice parameters	10.10 Å
Density	9.2 g/cm ³
Mohs hardness	5
Transmission Range	0.45-6 μm
Refractive Index	2.54@0.63 μm
Optical Activity	42 deg/mm@500 nm
Electro-optic coefficient	$r_{41} = 5 \text{ pm/V}$
Dielectric constant (low frequency)	56
Dark resistance	10 ¹⁴ Ohm cm

Standard products

FACE DIMENSIONS	LENGTH	ORIENTATION	SKU
5 x 5 mm	5 mm	[100]	6885
	5 mm	[110]	6884
10 x 10 mm	5 mm	[100]	6883
	5 mm	[110]	6882
20 x 20 mm	1,1 mm	[100]	6881
	1,1 mm	[110]	6880
25 x 25 mm	1,1 mm	[110]	27782
30 x 30 mm	1,1 mm	[110]	1558
	1,4 mm	[110]	9095