BBO β-Barium borate

DESCRIPTION

β-BBO Nonlinear Crystal—a widely used nonlinear crystal for frequency conversion in the ultraviolet, visible and near-infrared.

As one of the most important nonlinear optical crystals, beta-barium borate (β-BaB2O4 β-BBO) combines many outstanding features such as its high nonlinear optical coefficients, low group-velocity dispersion, broad transparency range (189–3500 nm) and high damage threshold. This unique combination ensures β-BBO crystal a promising candidate for a wide range of nonlinear optical applications such as frequency converters and optical parametric oscillators. In the realm of quantum optics, β-BBO crystal can be used to generate entangled photon pairs and ten-photon entanglement.

BBO is a negative uniaxial crystal, which provides phase matching for various second-order interactions almost over its entire transparency range (from 185 nm to 3.3 μm, as deduced from the transmittance measurements using crystal samples of several mm thickness), making it a widely used crystal for nonlinear frequency conversion in the ultraviolet, visible and near-infrared. In that regard, BBO is the most important nonlinear crystal for near infrared optical parametric chirped pulse amplifiers, which currently deliver few optical cycle pulses with high average and ultrahigh peak powers.

FEATURES

- The range of transmission is from 190 nm to 3500nm
- Appropriate mechanical properties
- Large effective SHG coefficient
- The range of phase matching is large from 409.6 nm to 3500nm
- Optical homogeneity is high:$\delta n \approx 10^{-6}$/cm
- Good physical properties

APPLICATIONS

- Electro-optic crystal for Pockels cells
- 266nm laser used in material processing
- 532nm laser used in medical area
- OPO

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PARAMETERS

PHYSICAL AND CHEMICAL PROPERTIES

Property	Value
Chemical formula	BaB_2O_4
Crystal structure	Trigonal, 3m
Lattice Parameter	a=b=12.532Å c=12.717Å, Z=6
Mass density	3.85 g/cm^3
Moh hardness	4
Melting point	About 1095°C
Thermal conductivity	1.2 W/m/K (⊥c) 1.6 W/m/K (//c)
Thermal expansion coefficient	α,4×10^{-6}/K; c,36×10^{-6}/K
Chamfer	0.1mm@45°
Birefringence	Negative uniaxial

EXPERIMENTAL VALUES OF INTERNAL ANGULAR BANDWIDTHS AT T =293K

Interacting wavelengths(nm)	θ_{pm} [deg]	$\Delta\theta^{int}$ [deg]
SHG, o+o → e		
1064 → 532	22.8	0.021
532 → 266	47.3	0.01
SFG, o+o → e		
1064+532 → 354	31.3	0.01
2688+571 → 471	21.8	0.028
SHG, e+o → e		
1064 → 532	32.7	0.034
SFG, e+o → e		
1064+532 → 355	38.4	0.02
SFG, o+e → e		
1064+532 → 355	58.4	0.05

NONLINEAR OPTICAL PROPERTIES

Property	Value
SHG Phase Matchable Range	409.6~500nm (Type I); 525~3500nm (TypeII)
NLO coefficients	d_{11}= 5.8 x d_{36}(KDP) d_{31} = 0.05 x d_{11} d_{22}< 0.05 x d_{11} $d_{eff}(I)=d_{31}\sin\theta+(d_{11}\cos3\varphi-d_{22}\sin3\varphi)\cos\theta$ $d_{eff}(II)=(d_{11}\sin3\varphi+d_{22}\cos3\theta)\cos2\theta$
Therm-Optic Coefficients	$d_{no}/dT = -9.3\times10^{-6}/℃$ $d_{ne}/dT = -16.6\times10^{-6}/℃$
Damage Threshold at 1064nm at 532nm	 5 GW/cm^2 (10 ns); 10 GW/cm^2 (1.3 ns) 1 GW/cm^2 (10 ns); 7 GW/cm^2 (250 ps)
Transparency Range	189 – 3500 nm
Absorption Coefficient	α<0.1%/cm @1064nm
RefractiveIndices at 1064nm at 532nm at 266nm	 n_e = 1.5425, n_o = 1.6551 n_e = 1.5555, n_o = 1.6749 n_e = 1.6146, n_o = 1.7571

EXPERIMENTAL VALUES OF PHASE-MATCHING ANGLE (T =293K)

Interacting wavelengths[nm]	θ_{exp} [deg]
SHG, o+o → e	
400 → 200	90
415 → 207	79.2
476 → 328	57
510 → 255	50
532 → 266	47.3
604 → 302	40
710 → 355	33
780 → 390	30
800 → 400	26.5
946 → 473	24.9
1064 → 532	22.7
SHG, e+o → e	
532 → 266	81
710 → 355	48
1064 → 532	32.4

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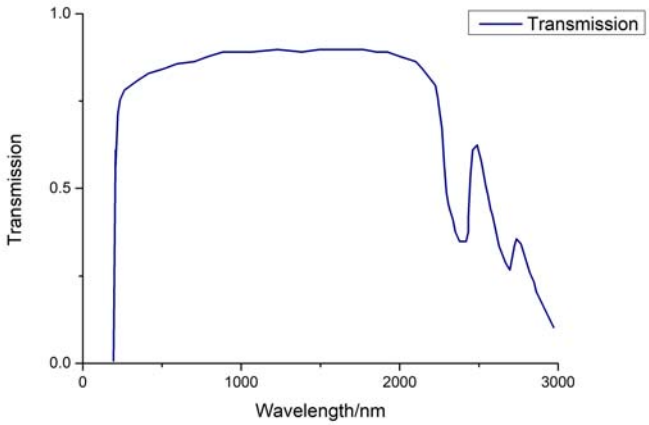
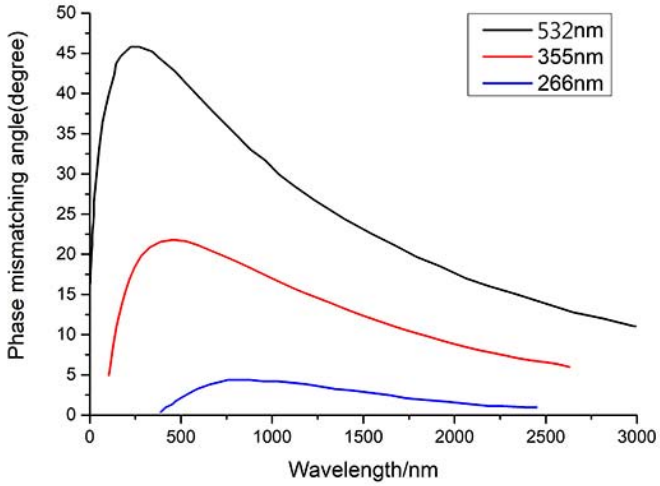
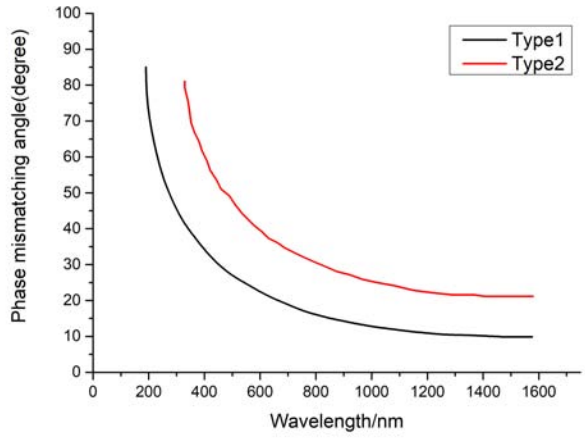
SPECTRA



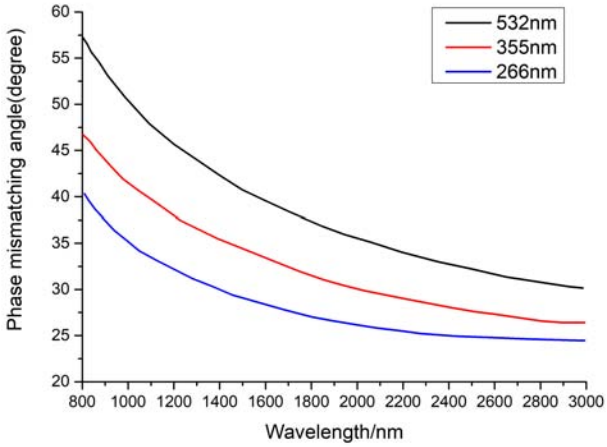
BBO Transmission Spectrum



OPO tuning curves of BBO (Typel (ooe)) with different pump light, namely 530 nm, 355 nm and 266 nm



SHG tuning curves of BBO



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