

# BIBO - Bismuth Triborate ( $\text{BiB}_3\text{O}_6$ )

## Introduction

Bismuth Triborate ( $\text{BiB}_3\text{O}_6$  or BIBO) is a newly developed nonlinear optical crystal. It possesses large effective nonlinear coefficient, high damage threshold and inertness with respect to moisture. Its nonlinear coefficient is 3.5-4 times higher than that of LBO, 1.5-2 times higher than that of BBO. It is a promising doubling crystal to produce blue laser. The top-seeded solution growth (TSSG) technique is used at CASTECH for the growth of BIBO single crystals.

## CASTECH offers

- Strict quality control;
- Large crystal size up to  $10 \times 10 \times 15 \text{ mm}^3$ ;
- AR-coating mounts and re-working services;
- A large quantity of crystals in stock;
- Fast delivery (15 days for polished only, 20 days for AR-coated).

## Basic Properties

Table 1. Chemical and Structural Properties

Crystal Structure	Monoclinic, Point group $C_2-2$
Lattice Parameter	$a = 7.116 \text{ \AA}$ , $b = 4.993 \text{ \AA}$ , $c = 6.508 \text{ \AA}$ , $\beta = 105.62^\circ$ , $Z = 2$
Melting Point	726 °C
Mohs Hardness	5-5.5 Mohs
Density	5.033 g/cm <sup>3</sup>
Thermal Expansion Coefficients	$\alpha_a = 4.8 \times 10^{-5}/\text{K}$ , $\alpha_b = 4.4 \times 10^{-6}/\text{K}$ , $\alpha_c = -2.69 \times 10^{-5}/\text{K}$

Table 2. Optical and Nonlinear Optical Properties

Transparency Range	286 - 2500 nm	
Absorption Coefficients	< 0.1%/cm at 1064 nm	
Physical Axis	$X // b$ , $(Z, a) = 31.6^\circ$ , $(Y, c) = 47.2^\circ$	
SHG of 1064/532 nm	Phase matching angle	168.9 ° from Z axis in YZ plane
	Deff	$3.0 \pm 0.1 \text{ pm/V}$
	Angular acceptance	2.32 mrad·cm
	Walk-off angle	25.6 mrad
	Temperature acceptance	2.17 °C·cm

Sellmeier coefficients	$n_i^2(\lambda) = A + B / (\lambda^2 - C) - D \lambda^2$ ( $\lambda$ in $\mu\text{m}$ )			
	A	B	C	D
$n_1$	3.6545 (4)	0.0511 (2)	0.0371 (3)	0.0226 (1)
$n_2$	3.0740 (3)	0.0323 (1)	0.0316 (3)	0.01337 (6)
$n_3$	3.1685 (3)	0.0373 (1)	0.0346 (3)	0.01750 (8)

## BIBO's Parameters

Table 3. Specifications

Dimension Tolerance	$(W \pm 0.1 \text{ mm}) \times (H \pm 0.1 \text{ mm}) \times (L + 0.5/-0.1 \text{ mm}) (L \geq 2.5 \text{ mm})$ $(W \pm 0.1 \text{ mm}) \times (H \pm 0.1 \text{ mm}) \times (L + 0.1/-0.1 \text{ mm}) (L < 2.5 \text{ mm})$
Clear Aperture	Central 90% of the diameter
Surface Quality (Scratch/Dig)	10/5 to MIL-PRF-13830B
Flatness	$\leq \lambda/8 @ 633 \text{ nm}$
Transmitted Wavefront Distortion	$\leq \lambda/8 @ 633 \text{ nm}$
Parallelism	20 arc sec
Perpendicularity	$\leq 15 \text{ arc min}$
Angle Tolerance	$\Delta\theta \leq 0.25^\circ, \Delta\Phi \leq 0.25^\circ$
Chamfer	$\leq 0.2 \text{ mm} \times 45^\circ$
Chip	$\leq 0.1 \text{ mm}$
Damage Threshold	$> 0.3 \text{ GW/cm}^2 @ 1064 \text{ nm}, 10 \text{ ns}, 10 \text{ Hz (AR-Coated)}$
Quality Warranty Period	One year under proper use.

## Coatings

- Dual or triple band AR-coatings of BIBO for SHG and THG applications
- Broad Band AR-coating (BBAR) and P-coating of BIBO for OPO applications
- Low reflectance
- Long durability
- Other coatings are available upon request