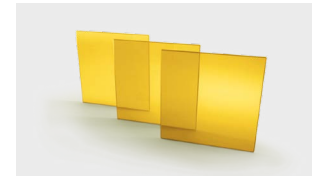


Photorefractive crystals

4Lasers provide BSO, Fe:LiNbO₃, SBN and BGO crystals not mainly, but necessarily for applications, which exploit photorefractive effect. Photorefractive effect is a phenomenon whereby the local index of refraction is modified by spatial variations of light intensity. It is observed when coherent light interferes with each other in photorefractive material, which forms a spatially varying pattern of illumination. The effect can be used to store temporary, erasable holograms, also known as holographic data storage. It can also be used to create phase-conjugate mirrors or optical spatial solitons.



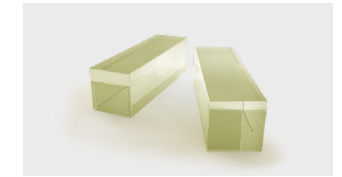
BSO crystals



BGO crystals

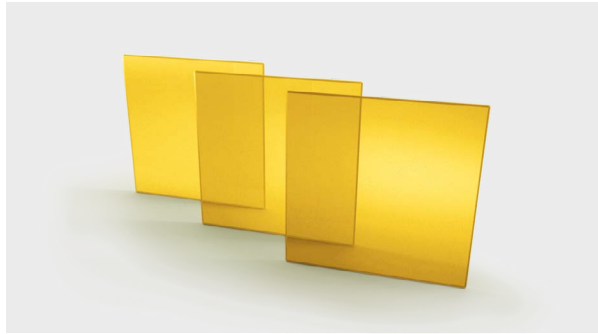


Fe:LiNbO₃ crystals



SBN crystals

BSO crystals



Bismuth silicic 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.

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

Standard specifications

BSO CRYSTALS	
Clear aperture	85%
Face dimensions tolerance	+0/-0,2 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	< $\lambda/4 @ 632,8 \text{ nm}$
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	PRICE
5 x 5 mm	5 mm	[100]	6885	520 €
	5 mm	[110]	6884	520 €
10 x 10 mm	5 mm	[100]	6883	680 €
	5 mm	[110]	6882	680 €
20 x 20 mm	1,0 mm	[100]	6881	490 €
	1,0 mm	[110]	6880	490 €
30 x 30 mm	1,0 mm	[110]	1558	590 €
	1,5 mm	[110]	9095	590 €

Fe:LiNbO₃ crystals



Lithium niobate (LiNbO₃, LN) crystal doped with iron (Fe:LiNbO₃) is an attractive photorefractive material, due to the high photorefractive sensitivity, high electro-optic coefficients and diffraction efficiency, chemo-mechanical properties. Fe:LiNbO₃ crystals are

grown by Czochralsky method and available in large size. Wide range of available dopants and levels enable to adjust material properties for particular applications. What is more, Fe:LiNbO₃ crystals are easy to handle, low cost, therefore suitable for volume production.

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
- Holographic recording
- Optical waveguides

Standard specifications

FE:LiNbO ₃ CRYSTALS	
Dopant level, Fe ₂ O ₃	0,02 mol. % 0,03 mol. % 0,05 mol. % 0,1 mol. %
Orientation	90° cut (X-cut, Y-cut)
Clear aperture	85%
Face dimensions tolerance	+0/-0,2 mm
Thickness tolerance	±0,2 mm
Parallelism error	<3 arcmin
Protective chamfers	<0,3 mm at 45°
Surface quality	20-10 S-D
Wavefront distortion	<λ/4@632,8 nm
Coatings	None, antireflective or indium tin oxide coatings available upon request
Electrodes	None, available upon request
Mount	Unmounted

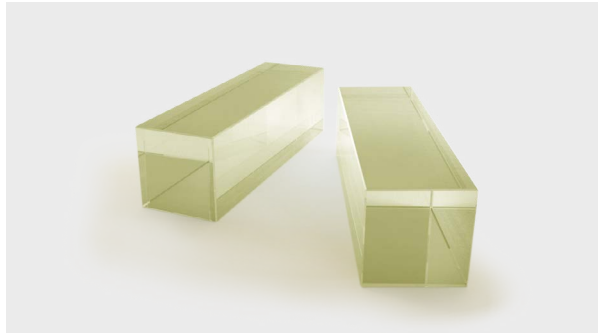
Properties

MAIN PROPERTIES	
Chemical formula	Fe:LiNbO ₃
Crystal structure	Trigonal, 3m
Density	4,64 g/cm ³
Mohs hardness	5
Transmission range	0,35-5,5 μm
Refractive index @0.63 μm	$n_o = 2,20$ $n_e = 2,29$
Electro-optic coefficients	$r_{22} = 6,8 \text{ pm/V}$ $r_{31} = 10 \text{ pm/V}$ $r_{33} = 32 \text{ pm/V}$
Dielectric constant	$\epsilon_{11} = 85$ $\epsilon_{33} = 30$

Standard products

FACE DIMENSIONS	LENGTH	DOPING	SKU	PRICE
10 x 10 mm	1 mm	0,02 % Fe ₂ O ₃	7006	495 €
		0,03 % Fe ₂ O ₃	7007	495 €
		0,05 % Fe ₂ O ₃	7008	495 €
		0,1 % Fe ₂ O ₃	7009	495 €
10 x 10 mm	5 mm	0,02 % Fe ₂ O ₃	6457	Request
		0,03 % Fe ₂ O ₃	6458	Request
		0,05 % Fe ₂ O ₃	4052	Request
		0,1 % Fe ₂ O ₃	7005	Request
20 x 20 mm	1 mm	0,02 % Fe ₂ O ₃	7010	Request
		0,03 % Fe ₂ O ₃	7011	Request
		0,05 % Fe ₂ O ₃	7012	Request
		0,1 % Fe ₂ O ₃	7013	Request

SBN crystals



Strontium-barium niobate ($\text{Sr}_x\text{Ba}_{1-x}\text{Nb}_2\text{O}_6$, SBN:x, $x = 61$) crystals feature excellent optical and photorefractive properties. They are available nominally pure or doped with Ce. Different composition SBN crystals found their application in electro-optics, acousto-optics,

photorefractive, non-linear optics fields. 4Lasers provide inclusion-free and homogenous SBN crystals, which are grown by Modified Stepanov method and available with linear dimensions up to 40 mm.

Main features

- Pure or doped with Ce
- Efficient phase-conjugation
- Custom size, doping level, unpoled, antireflective coated and electrodeless crystals are available upon request.

Application examples

- Optical information recording
- Pyroelectrical detectors
- Self-pumped self-conjugation mirror
- Optical correlators

Standard specifications

SBN:61 CRYSTALS	
Orientation	Short edge along tetragonal axis
Poling	Poled or unpoled
Electrodes	Carbon-water electrodes or no electrodes
Clear aperture	85%
Face dimensions tolerance	+0/-0,2 mm
Thickness tolerance	±0,2 mm
Parallelism error	<30 arcsec
Protective chamfers	<0,1 mm at 45°
Surface quality	40-20 S-D over clear aperture, 60-40 S-D other surfaces
Surface flatness	<λ/4@632,8 nm
Coatings	Uncoated
Mount	Unmounted

Properties

MAIN PROPERTIES	
Composition	SBN:61
Crystal structure	Tetragonal, 4 mm
Lattice parameters	a = 12,46 Å, c = 3,946 Å
Density	5,4 g/cm ³
Mohs hardness	5,5
Melting temperature	1480°C
Curie temperature	75°C
Transparency range	0,45-5,5 μm
Refractive index @633 nm	n _o = 2,3103 n _e = 2,2817
Δn @633 nm	-0,0286
Half-wave voltage (λ/2)	240 V
Dielectric constant, (T = 293 K)	900
Electro-optic coefficients	r ₁₃ = 45 pm/V r ₃₃ = 250 pm/V
Pyroelectric coefficient	0,065 μC cm ⁻² K ⁻¹
Dielectric constant	880

Standard products

MATERIAL	FACE DIMENSIONS	LENGTH	DOPING	SKU	PRICE	
SBN:61	5 x 5 mm	5 mm	Undoped	73	1850 €	
			CeO2 0,002 wt, %	6940	1850 €	
			CeO2 0,01 wt, %	6944	1850 €	
			Undoped	74	2250 €	
			CeO2 0,002 wt, %	6941	2250 €	
			CeO2 0,01 wt, %	6945	2250 €	
		10 mm	Undoped	75	2750 €	
			CeO2 0,002 wt, %	6942	2750 €	
			CeO2 0,01 wt, %	6946	2750 €	
			15 mm	Undoped	76	3400 €
				CeO2 0,002 wt, %	6943	3400 €
				CeO2 0,01 wt, %	6947	3400 €

BGO crystals



Bismuth germanite ($\text{Bi}_{12}\text{GeO}_{20}$, BGO) 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.

Main features

- High electro-optic coefficient [$r_{41} = 3,5 \text{ pm/V}$]
- Low dark conductivity
- Large size elements or wafers up to 3"
- Customization available upon request

Application examples

- Spatial light modulators
- Optical switches
- Optical correlators

Standard specifications

BGO CRYSTALS	
Clear aperture	85%
Face dimensions tolerance	+0/-0,2 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	< $\lambda/4 @ 632,8 \text{ nm}$
Coatings	Uncoated
Mount	Unmounted

Properties

MAIN PROPERTIES	
Chemical formula	$\text{Bi}_{12}\text{GeO}_{20}$
Crystal structure	Cubic, point group 23
Lattice parameters	10,15 Å
Density	9,2 g/cm ³
Transmission Range	0,45-7 μm
Refractive Index @0.63μm	2,55
Optical Activity @500 nm	41,5 deg/mm
Electro-Optic Coefficient r_{41}	3,5 pm/V
Dielectric constant	40
Dark Resistance	10^{14} Ohm cm

Standard products

FACE DIMENSIONS	LENGTH	ORIENTATION	SKU	PRICE
5 x 5 mm	5 mm	[100]	6871	520 €
	5 mm	[110]	6868	520 €
10 x 10 mm	5 mm	[100]	6873	680 €
	5 mm	[110]	6872	680 €
20 x 20 mm	1 mm	[100]	6875	490 €
	1 mm	[110]	6874	490 €
30 x 30 mm	1 mm	[110]	6876	590 €
	1,5 mm	[110]	6877	590 €