LASER COMPONENTS

Lithium Niobate Crystal Series ($LiNbO_3$, $MgO:LiNbO_3$)

Lithium Niobat Crystal ($LiNbO_3$)

$LiNbO_3$ crystal is widely used as frequency doublers for wavelength >1 µm and optical parametric oscillators (OPOs) pumped at 1064 nm as well as quasi-phase-matched (QPM) devices. Due to its large Electro-Optic (E-O) and Acousto-Optic (A-O) coefficients, $LiNbO_3$ crystal is the most commonly used material for Pockel Cells, Q-switches and phase modulators, waveguide substrate, and Surface Acoustic Wave (SAW) wafers, etc.

We provide high quality and large size $LiNbO_3$ crystals for laser frequency doublers, OPOs and quasi-phase-matched doublers, as well as waveguide substrate and SAW wafers. High quality $LiNbO_3$ components with aperture of (2 – 15) x (2 – 15) mm^2 and length up to 50 mm for frequency doublers and optical parametric oscillators (OPOs), 50x50x1 mm^3 or Dia. 3" x 1 mm $LiNbO_3$ substrate for waveguide optics, and Dia. 3" SAW wafers are available with high volume and at low price.

Basic Properties

Crystal structure	trigonal, space group R3c
Cell parameters	a = 0.515, c = 13.863, Z = 6
Melting point	1255 ± 5 °C
Curie point	1140 ± 5 °C
Mohs hardness	5
Density	4.64 g/cm^3
Absorption coefficient	~0.1%/cm @ 1064 nm
Solubility	insoluble in H_2O
Relative dielectric constant	$\varepsilon^T_{11}/\varepsilon_0$: 85 $\varepsilon^T_{33}/\varepsilon_0$: 29.5
Thermal expansion coefficients (@ 25 °C)	|| a, 2.0 x 10^{-6}/K || c, 2.2 x 10^{-6}/K
Thermal conductivity	38 W/m/K @ 25 °C

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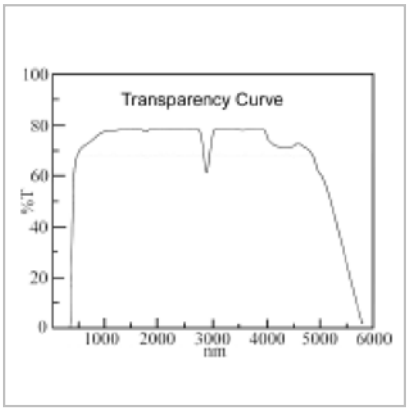
Lithium Niobate Crystal Series ($LiNbO_3$, $MgO:LiNbO_3$)

Linear Optical Properties

Transparency range	420 – 5200 nm
Refractive indices	n_e = 2.146, n_o = 2.220 @ 1300 nm n_e = 2.156, n_o = 2.232 @ 1064 nm n_e = 2.203, n_o = 2.286 @ 632.8 nm
Optical homogeneity:	~5 x 10^{-5} /cm
Sellmeier equations (λ in µm):	$n^2_o(\lambda) = 4.9048 + 0.11768/(\lambda^2 - 0.04750) - 0.027169 \times \lambda^2$ $n^2_e(\lambda) = 4.5820 + 0.099169/(\lambda^2 - 0.04443) - 0.021950 \times \lambda^2$



Nonlinear Optical Properties

NLO coefficients	d_{33} = 34.4 pm/V $d_{31} = d_{15}$ = 5.95 pm/V d_{22} = 3.07 pm/V	
Efficiency NLO coefficients	d_{eff} = 5.7 pm/V or ~ 14.6 x d_{36} (KDP) for frequency doubling 1300 nm; d_{eff} = 5.3 pm/V or ~ 13.6 x d_{36} (KDP) for OPO pumped at 1064 nm; d_{eff} = 17.6 pm/V or ~ 45 x d_{36} (KDP) for quasi-phase-matched structure.	
Electro-optic coefficients	γ^{T33} = 32 pm/V, γ^{T31} = 10 pm/V, γ^{T22} = 6.8 pm/V,	γ^{S33} = 31 pm/V γ^{S31} = 8.6 pm/V, γ^{S22} = 3.4 pm/V,
Half-wave voltage, DC Electrical field || z, light ⊥ z: Electrical field || x or y, light || z:	 3.03 KV 4.02 KV	
Damage threshold	100 MW/cm² (10 ns, 1064 nm)	

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Standard Specifications of Laser Grade $LiNbO_3$ Crystals

Transmitted wavefront distortion	better than λ/4 @ 633nm
Dimension tolerance	(W ± 0.1 mm) x (H ± 0.1 mm) x (L ± 0.2 mm)
Clear aperture	over 90% central diameter
Flatness	λ/8 @ 633nm
Surface quality	20 /10 scratch/dig
Parallelism	better than 20 arc sec
Perpendicularity	5 arc min
Angle tolerance	$\Delta\theta < 0.5°$, $\Delta\phi < 0.5°$
AR-coating	dual wave band AR coating at 1064/532 nm on both surfaces, with R<0.2% at 1064 nm and R<0.5% at 0.532 nm per surface 0.5% at 0.532 nm per surface

Other custom specs. or coatings for $LiNbO_3$ crystals are also available upon request.

Magnesium Oxide Doped Lithium Niobate Crystals ($MgO:LiNbO_3$)

Compared with $LiNbO_3$ crystal, $MgO:LiNbO_3$ crystal exhibits its particular advantages for NCPM frequency doubling (SHG) of Nd:Lasers, mixing (SFG) and optical parametric oscillators (OPOs). The SHG efficiencies of over 65% for pulsed Nd:YAG lasers and 45% for cw Nd:YAG lasers have been achieved in $MgO:LiNbO_3$ crystals, respectively. $MgO:LiNbO_3$ is also a good crystal for optical parametric oscillators (OPOs) and amplifiers (OPAs), quasi-phase-matched doublers and integrated waveguide.
$MgO:LiNbO_3$ has similar effective nonlinear coefficients to pure $LiNbO_3$. Its Sellmeier equations (for MgO dopant 7 mol%) are:

$$n^2_o(\lambda) = 4.8762 + 0.11554/(\lambda^2 - 0.04674) - 0.033119 \times \lambda^2 \qquad (\lambda \text{ in } \mu m)$$

$$n^2_o(\lambda) = 4.5469 + 0.094779/(\lambda^2 - 0.04439) - 0.026721 \times \lambda^2$$

We provide high quality MgO: $LiNbO_3$ crystals for various nonlinear optics (NLO) and E-O applications. The typical size of $MgO:LiNbO_3$ crystals is (3 - 10) x (3 - 10) x (10 - 30) mm^3 for OPOs & OPAs and frequency doubling & mixing, and 20x20x1 mm^3 for waveguide substrates. Other specs. and AR-coatings for $MgO:LiNbO_3$ are available upon request.

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