Lithium Niobate Crystal ($LiNbO_3$)

Introduction

$LiNbO_3$ Crystal is widely used as frequency doublers for wavelength >1μm and optical parametric oscillators (OPOs) pumped at 1064 nm as well as quasi-phase-matched (QPM) devices. Additionally 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. **CASTECH** can provide $LiNbO_3$ crystals with high quality and large size for all these applications.

Structural and Physical Properties of $LiNbO_3$

Crystal Structure:	Trigonal, Space group R3c, Point group 3m
Cell Parameters:	a=5.148 Å , c=13.863 Å
Melting Point:	1253°C
Curie Temperature:	1140°C
Mohs Hardness:	5
Density:	4.64 g/cm^3
Elastic Stiffness Coefficients	C^E_{11}=2.33(×10^{11}N/m^2) C^E_{33}=2.77(×10^{11}N/m^2)

Optical and Electro-optical Properties of $LiNbO_3$

Transparency Range:	420-5200nm
Optical Homogeneity:	~ 5 x 10^{-5} /cm
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
NLO Coefficients:	d_{33} = 86 x d_{36} (KDP) d_{31} =11.6 x d_{36} (KDP) d_{22} = 5.6 x d_{36} (KDP)
Effective NLO Coefficients:	$d_{eff}(I)=d_{31}\sin\theta-d_{22}\cos\theta\sin3\phi$ $d_{eff}(II)=d_{22}\cos^2\theta\cos3\phi$
Electro-Optic Coefficients	γ^T_{33} = 32 pm/V, γ^S_{33} = 31 pm/V, γ^T_{31} =10 pm/V, γ^S_{31}=8.6 pm/V, γ^T_{22} = 6.8 pm/V, γ^S_{22}= 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/cm^2 (10 ns, 1064nm)

Thermal and Electrical Properties of $LiNbO_3$

Melting Point:	1250°C
Curie Temperature:	1140°C
Thermal Conductivity:	38W/m/K @25°C
Thermal Expansion Coefficients (at 25°C):	//a, 2.0×10^{-6}/K //c, 2.2×10^{-6}/K
Resistivity:	$2\times10^{-6}\,\Omega\cdot$cm @200°C
Dielectric Constants:	$\varepsilon^S_{11}/\varepsilon_0$ =43 $\quad$ $\varepsilon^T_{11}/\varepsilon_0$=78 $\varepsilon^S_{33}/\varepsilon_0$ =28 $\quad$ $\varepsilon^T_{33}/\varepsilon_0$= 32
Piezoelectric Strain Constant:	D_{22}=2.04($\times10^{-11}$C/N) D_{33}=19.22 ($\times10^{-11}$ C/N)

The Sellmeier equations (λ in μm) :

$$n_o^2 = 4.9048 + 0.11768 / (\lambda^2 - 0.04750) - 0.027169\lambda^2$$
$$n_e^2 = 4.5820 + 0.099169 / (\lambda^2 - 0.04443) - 0.02195\lambda^2$$

Specifications

- Transmitting wavefront distortion: less than λ/4 @ 633 nm
- Dimension tolerance: (W ± 0.1 mm) x (H ± 0.1 mm) x (L ± 0.2mm)
- Clear aperture: > 90% central area
- Flatness: λ/8 @ 633 nm
- Scratch/Dig code: 20/10 to MIL-PRF-13830B
- Parallelism: better than 20 arc seconds
- Perpendicularity: 5 arc minutes
- Angle tolerance: < ± 0.5°
- AR coating: dual wave band AR coating at 1064/532 nm on both surfaces, with R < 0.2% at 1064nm and R < 0.5% at 532nm per surface.

Other coatings are available upon request.