Inradoptics

Chemical Formula:	**$LiNbO_3$**
Crystal Symmetry:	**trigonal**
Optical Symmetry:	**uniaxial negative**
Class:	**3m**

$LiNbO_3$ Single Crystals

Lithium niobate is a ferroelectric material suitable for a variety of applications. Its versatility is made possible by the excellent electro-optic, nonlinear, and piezoelectric properties of the intrinsic material. It is one of the most thoroughly characterized electro-optic materials, and crystal growing techniques consistently produce large crystals of high perfection. Applications that utilize the large electro-optic coefficients of lithium niobate are optical modulation and Q-switching of infrared wavelengths. Because the crystal is nonhygroscopic and has a low half-wave voltage, it is often the material of choice for Q-switches in military applications. The crystal can be operated in a Q-switch configuration with zero residual birefringence and with an electric field that is transverse to the direction of light propagation. Because piezoelectric ringing can be severe, piezoelectrically damped designs can be very useful. The damage threshold of the intrinsic material at 1.06 microns with a 10 nsec pulse is approximately 3 J/cm2. With appropriate AR coatings, a surface damage threshold of 300-500 MW/cm2 can be achieved for the same conditions.

Applications that use the large nonlinear d coefficient of $LiNbO_3$ include optical parametric oscillaton, difference frequency mixing to generate tunable infrared wavelengths, and second harmonic generation. With a broad spectral transmission, which ranges from 0.4 Qm to 5.0 Qm with an OH- absorption at 2.87 Qm, a large negative birefringence, and a large nonlinear coefficient, phasematching is an effective way to generate tunable wavelengths over a broad wavelength range.

Lithium niobate is particularly effective for second harmonic generation of low power laser diodes in the 1.3 to 1.55 Qm range.

For infrared generation by difference frequency mixing, the peak power limit is considerably lower than for 1.064 Qm, being about 40 MW/cm2. Efficiencies for difference frequency mixing generally are smaller than shg efficicncies with KDP or BBO, which is due to the lower peak powers that can be tolerated by the crystal and the fact that the longer wavelength photons that are generated in the process are less energetic. Typical powers for 10 nanosecond long pulses with 5 mm diameter beams are 30 mJ/pulse of 0.640 Qm minus 40 mJ/pulse of 1.064 Qm to produce 2.5 mJ/pulse at 1.54 Qm, and 32 mJ/pulse of 0.532 Qm minus 32 mJ/pulse of 0.640 Qm to produce 0.25 mJ/pulse at 3.42 Qm.

Inrad offers optical grade lithium niobate in a variety of configurations. Standard cuts are available as OPO crystals, Q-switches, difference frequency mixing crystals and autocorrelation.

Please consult an Inrad sales engineer for assistance in crystal selection and packaging.

At Inrad, all crystal growth, orientation, fabrication, polishing, and testing of $LiNbO_3$ is done at one site so that

you are assured of complete traceability and satisfaction with every crystal that you purchase.

In order to simplify manufacturing, stocking, and ordering, a number of standard sizes and orientations have been defined. If the size and orientation that you want is not listed here, please send a Request For Quotation to us!

Different orientations, crystallographically speaking, refer to the angles between the beam propagation direction and the crystallographic direction of the optic axis.

All of the frequency-mixing orientations that are listed here are Type I, meaning that the polarization directions of the two longest wavelengths in the mixing process are in the same direction; the shortest wavelength in the mixing process has an orthogonal polarization direction.

Examples of tuning applications are given for each crystal cut; other applications are possible.

$LiNbO_3$ Single Crystals		
Size (mm)	Corresponding INRAD Cells	Notes
10 x 10 x 0.5	530-081	autocorrelation
10 x 10 x 1.0	530-081	autocorrelation
10 x 10 x 5.0	530-080LD	autocorrelation
10 x 10 x 30	usually not mounted	OPO size
9 x 9 x 25**	PLC01-DC08	Q-switch size
13.3 x 18.5 x 30	563-1117	Autotracker size

***The standard 9 x 9 x 25 mm crystal is z-cut, gold electroded, and ar-coated for 1064 nm. All other crystals typically are uncoated*

$LiNbO_3$ Standard Orientations*				
Designation	Angle θ	Operation	Input	Output
"A"	68.8°	DFM	(564-600 nm) - 1064 nm	1200-1380 nm
"B"	59.8°	DFM	(600-664 nm) - 1064 nm	1370-1770 nm
		SHG	1310 nm	655 nm
"C"	50.8°	DFM	(664-923 nm) - 1064 nm	1770-4000 nm
		SHG	1550 nm	775 nm
"D"	47°	DFM	1064 - (1450-2000 nm)	2300-4000 nm
"OPO"	47°	OPO	1064 nm	1450-4000 nm
"QS"	Z	Q-switch	-	-

**Orientations refer to the angles between the beam propagation direction and the crystallographic direction of the optic axis. All of the frequency-mixing orientations that are listed here are Type I, meaning that:*

- *Polarization directions of the two longest wavelengths in the mixing process are in the same direction*
- *The shortest wavelength in the mixing process has an orthogonal polarization direction.*