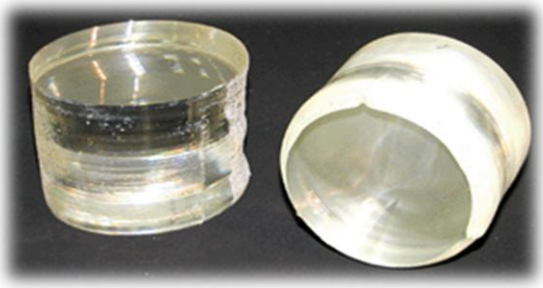
GAMDAN OPTICS

Lithium Niobate
(LiNbO3)



Gamdan grows boules (ingots of crystals) using specialized processes that have been refined over the past 30 years. Even the crystal synthesizing equipment is custom-engineered by Gamdan scientists.

Lithium niobate ($LiNbO_3$) crystals are widely used as electro-optic modulators and Q-switches for Nd:YAG, Nd:YLF and Ti:Sapphire lasers, as well as the modulators for fiber optics. The following table lists the specifications of the typical $LiNbO_3$ crystal used as Q-switch with transverse E-O modulation. The light beam travels in z-axis and electric field applies to x-axis. The electro-optic coefficients of $LiNbO_3$ are: r_{33} = 32 pm/V, r_{31} = 10 pm/V, r_{22} = 6.8 pm/V at low frequency, and r_{33} = 31 pm/V, r_{31}= 8.6 pm/V, r_{22} = 3.4 pm/V at high electric frequency. The half–wave voltage: $V_{\pi}=\lambda d/(2n_o^3 r_{22}L)$, $r_c=(n_e/n_o)^3 r_{33}-r_{13}$.

$LiNbO_3$ is a compound of niobium, lithium and oxygen. Its crystals have a trigonal crystal system and belong to the 3m crystallographic point group. Lithium niobate exhibits nonlinear optical polarizability and photoelasticity. The Chemical Abstracts Services (CAS) number for lithium niobate is [12031-63-9].

About GAMDAN

GAMDAN Optics synthesizes, custom designs and precision manufactures NLO crystals. Our exclusive **CrystalExpress**SM delivers California-grown crystals with exceptional quality in only 10 business days—the fastest in the industry.*

Gamdan also supplies custom nonlinear, acousto-optic, electro-optic and laser crystals.

*As of January 2008 per GAMDAN market survey. Precision cut and polish BBO and KTP crystals; coating times will vary.

Lithium Niobate

$LiNbO_3$ Q-Switch Specifications

Typical Crystal Size	9 X 9 X 25 mm^3 or 4 X 4 X 15 mm^3 Other sizes are available upon request.
Tolerance of Size	Z-axis: ± 0.2 mm X-axis and Y-axis:±0.1 mm
Chamfer	less than 0.5 mm at 45°
Accuracy of Orientation	Z-axis: <± 5' X-axis and Y-axis: < ± 10'
Parallelism	< 20"
Finish	10/5 Scratch/Dig
Flatness	λ/8 at 633nm
AR-Coating	R < 0.2% @ 1064nm
Electrodes	Gold/Chrome plated on X-faces
Wavefront Distortion	<λ/4 @ 633nm
Extinction Ratio	> 400:1 @ 633nm, φ6 mm beam

$LiNbO_3$ is also a good acousto-optic crystal and used for surface acoustic wave (SAW) wafer and A-O modulators. Gamdan offers acoustic (SAW) grade $LiNbO_3$ crystals in wafers, as-cut boules, finished components and custom fabricated elements.

Typical SAW Properties

Cut Type	SAW Velocity V_s (m/s)	Electromechanical Coupling Factor k^2_s (%)	Temperature Coefficient of Velocity TCV (10^{-6}/°C)	Temperature Coefficient of Delay TCD (10^{-6}/°C)
127.86° Y-X	3970	5.5	-60	78
Y-X	3485	4.3	-85	95

Typical Specifications

	Type			
	Boule		Wafer	
Diameter	Φ3"	Φ4"	Φ3"	Φ4"
Length or Thickness (mm)	≤100	≤50	0.35-0.5	
Orientations	127.86°Y, 64°Y, 135°Y, X, Y, Z, and other cuts			
Ref. Flat Orientation	X, Y			
Ref. Flat Length	22±2mm	32±2mm	22±2mm	32±2mm
Front Side Polishing	Mirror polished 5-15 Å			
Back Side Lapping	0.3-1.0μm			
Flatness (μm)	15			
Bow (μm)	25			

Other sizes and specifications of wafers are available upon request.

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