Properties of Stoichiometric LiTaO3

Properties		【Stoichiometric】 LiTaO3 (SLT)	【Congruent】 LiTaO3 (CLT)
Crystal system		Trigonal	
Space group		R3c	
Curie temperture : T_c(℃) data	T_c(℃)	690 695 (MgO-doped)	
[Li_2O]:[Ta_2O_5] mol ratio (estimated from Tc)		49.95:50.05	
Lattice parameters	c_0 (nm)	0.51509	
	a_0 (nm)	1.3773	
Absorption edge[2] data	(nm)	270	
Refractive index[3] data	n_o (nm)	2.1770 (@633nm)	
	n_e (nm)	2.1745 (@633nm)	
Birefringence	n_e-n_o(nm)	-0.0025 (@633nm)	
Linear EO constants[4]	r31(pm/V)	8.4 (@633nm)	
	r33(pm/V)	30.5 (@633nm)	
Non-linear optical constants[5](Based on CLT figures) data	d31(pm/V)	0.85	
	d33(pm/V)	13.8	
E-field for domain switch (coercive field)[6]	E_c (kV/mm)	＜ 1.7	approx.1/13 of CLT
Thermal conductivity [7] data	W/(m･K)	8.78 8.43 (MgO-doped)	approx.2 times CLT
Photorefractive damage threshold[8] data	MW/cm^2@532nm	2	approx.200 times CLT
GRIIRA [9] data	ppm/cm @3.6kW/cm^2 CW Green	<100 ～50 (MgO-doped)	<1/3 of CLT

[1]M.Nakamura et al., "Refractive Indices in Undoped and MgO-doped Near-Stoichiometric LiTaO3 Crystals", Jpn. J. Appl. Phys. **41** L465 (2002)
[2]Handbook of Advanced Electronic and Photonic Materials and Devices, edited by H.S. Nalwa, "Volume 4: Ferroelectrics and Dielectrics", Chapter 2, p..62 (2002)
[2] V.Gopalan et al., Crystal Growth, Characterization, and Domain Studies in Lithium Niobate and Lithium Tantalate Ferroelectrics
[3]M.Nakamura et al., "Refractive Indices in Undoped and MgO-doped Near-Stoichiometric LiTaO3 Crystals", Jpn. J. Appl. Phys. **41** L465 (2002)
[4]Onuki, K., Uchida, N., Saku, T., "Interferometric Method for Measuring Electro-ptic Coefficients in Crystals", J. Opt. Soc. Am. **62** (1972) 1030
[5]I.Shoji et al., "Absolute scale of second-order onlinear-optical coefficiencts" J.Opt. Soc. Am. B **14** p.2268 (1997)
[6]T.Hatanaka et al. "Quasi-phase-matched optical parametric oscillation with periodically poled stoichiometric LiTaO3", J.Opt. Soc. Am. B **14** p.2268 (1997)
[7]K. Kitamura et al., Oyo buturi **74**, p.573 (2005)
[8]K..Kitamura et al., "Non-stoichiometric control of LiNbO3 and LiTaO3 in ferroelectric domain engineering for optical devices", Ferroelectrics **257**, p.235 (2001)
[9]K..Kitamura et al., "Non-stoichiometric control of LiNbO3 and LiTaO3 in ferroelectric domain engineering for optical devices", Ferroelectrics **257**, p.235 (2001)

◆Curie termperature

Table 1. Curie temperatures of the undoped and MgO (0.5 and 1-mol%)-doped SLT crystals, CLT crystal and ceramics of known [Li]/[Ta] ratio.

Sample	Curie temperature, T_c [°C]
SLT	688
MgO 0.5 mol% SLT	694
MgO 1 mol% SLT	695
CLT	604
Ceramics (Li/Ta=49.9/50.1)	686
Ceramics (Li/Ta=50/50)	694

◆Absorption edge

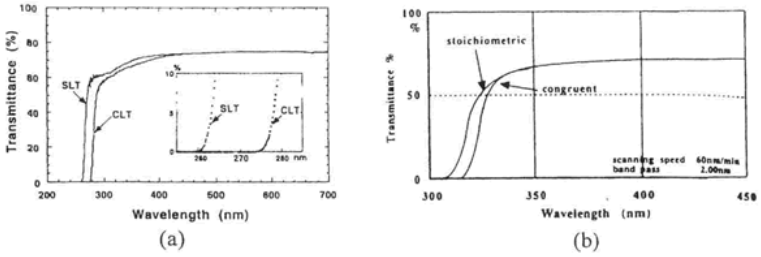
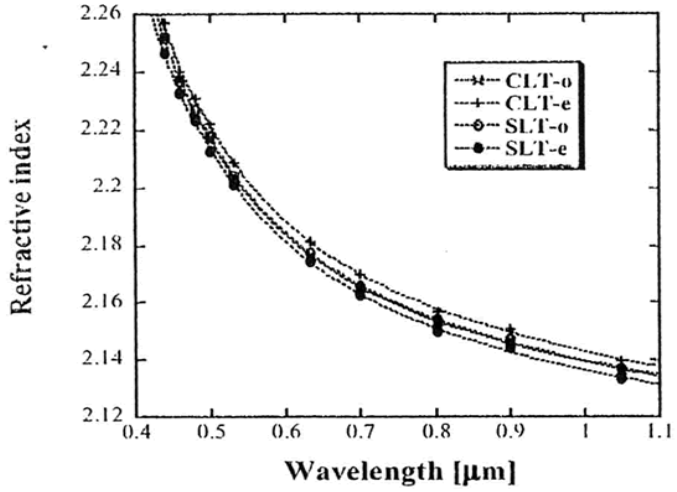


Fig. 5. (a) Transmittance spectrum of congruent and stoichiometric $LiTaO_3$ crystals. Reprinted from *J. Cryst. Growth*, 116, K. Kitamura et al., 327, © (1992), with permission from Elsevier Science. (b) Transmittance spectrum of congruent and stoichiometric $LiNbO_3$ crystals.

◆Refractive index



◆Non-linear optical constant

Table 10. Absolute Magnitudes of Second-Order Nonlinear-Optical Coefficients (pm/V)[a]

		Wavelength (Method of Measurement)					
					0.532 μm		
Crystal	d_{il}	1.313 μm (SHG)	1.064 μm (SHG)	0.852 μm (SHG)	DFG	PF	0.488 μm (PF)
Congruent $LiNbO_3$	d_{33}	19.5	25.2	25.7			
	d_{31}	3.2	4.6	4.8	4.3	4.3	4.8
1%MgO:$LiNbO_3$	d_{33}	20.3	24.9	27.5			
	d_{31}	3.2	4.6	4.8			
5%MgO:$LiNbO_3$	d_{33}	20.3	25.0	28.4			
	d_{31}	3.4	4.4	4.9			4.9
$LiTaO_3$	d_{33}	10.7	13.8	15.1			
	d_{31}		0.85				
$KNbO_3$	d_{33}	16.1	19.6	22.3			
	d_{31}	9.2	10.8	11.0			
	d_{15}		12.5				
KTP	d_{33}	11.1	14.6	16.6			
	d_{31}		3.7				
	d_{32}		2.2				
	d_{15}	2.6	3.7	3.9			
	d_{24}	1.4	1.9	1.9			
KDP	d_{36}		0.39				
Quartz	d_{11}		0.30				

[a]The wavelengths shown are the fundamental wavelengths for SHG and the pump wavelengths for DFG and PF.

◆Thermal conductivity

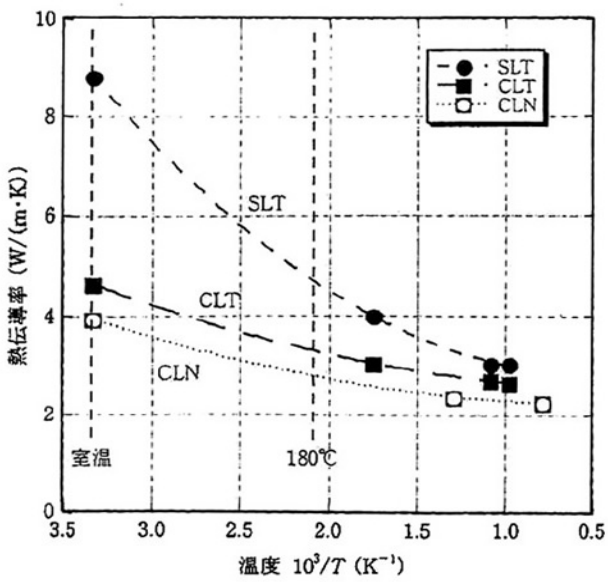


図9　SLT，CLT，CLN の熱伝導率の温度依存性．熱伝導率は温度と反比例し，室温から 200℃まで上昇すると著しく減少する．

◆Photorefractive damage threshold

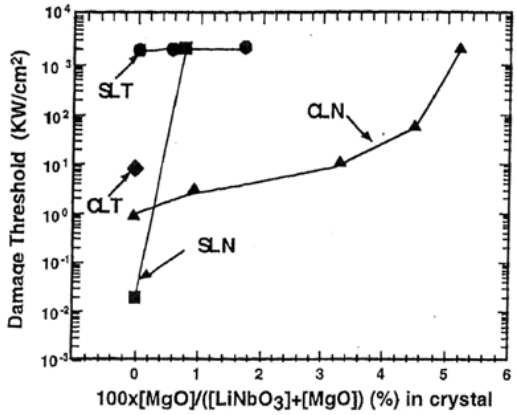


Figure 3. Photorefractive damage threshold behavior as a function of the MgO concentration in $LiNbO_3$ and $LiTaO_3$ crystals.

◆GRIIRA

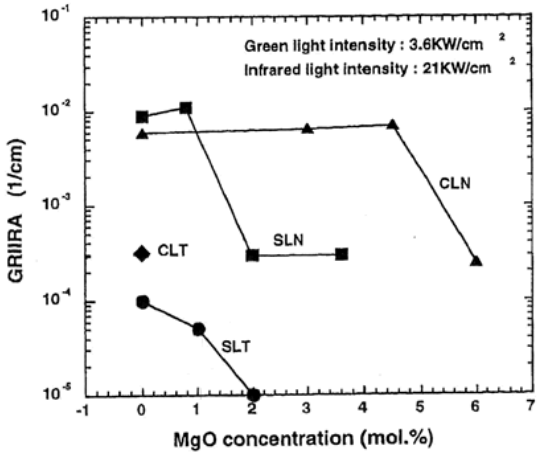


Figure 2. Green induced infrared absorption (GRIIRA) versus MgO concentration in $LiNbO_3$ and $LiTaO_3$ crystals.