

MgO:LiNbO₃ MgO doped LiNbO₃



DESCRIPTION

MgO:LiNbO₃ - A kind of nonlinear crystal optimize the performance of LiNbO₃

One of the most important drawbacks of popular LiNbO₃ crystal is its susceptibility to photorefractive damage (optically induced change of refractive index, usually under exposure with blue or green CW light). The usual way to eliminate this effect is to keep LN crystals at elevated temperatures (400K or more). Another way to prevent photorefractive damage is MgO-doping (usually at levels of around 5 mol% for congruent LN). What is good is that such MgO-doped congruent LiNbO₃ crystals have a much lower coercive field value than undoped LN crystals. Recently, it was shown that stoichiometric LiNbO₃ crystals, doped with only 1 mol% MgO, possess higher photorefractive damage threshold than 5 mol% MgO-doped congruent LN samples.

Pure LiNbO₃ (LN) is a good candidate for various optical devices, but has a major disadvantage due to its low threshold optical damage. MgO-doped LN (congruent compositions) is one of the possible solutions to deal with this problem. MgO doping has played an important role in LN and shown an increased threshold laser beam strength by 100 times. An interesting point is that every physical property of MgO-doped LN (e.g. transition temperature, activation energy, optical band, optical absorption spectra, shift of OH- vibration frequency, density, and electric activation energy based on our previous measurements⁴) has threshold composition at just above 5 mole% of MgO concentration.

FEATURES

- High Homogeneity
- Wide transparency range
- High damage threshold
- Good electro-optical properties
- Good photoelastic properties

APPLICATIONS

- SHG(second-harmonic generation), THG(third-harmonic generation)
- OPO(optical parametric oscillator)
- OPA(optical parametric amplification)
- OPCPA (optical parametric chirped-pulse amplification)
- Electro-optic modulator



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PARAMETERS

EXPERIMENTAL VALUES OF PHASE-MATCHING ANGLE (T = 293K)

Interacting wavelengths [μm]	Φ _{exp} [deg]	Note
SHG, o+o → e		
	74.5	5mol% MgO, congruent LN
	76	5mol% MgO
1064 → 532	76.5	5mol% MgO, Li/Nb=0.97
	82.3	7mol% MgO
1080 → 540	75.1	5mol% MgO, congruent LN
	74	5mol% MgO, Li/Nb=0.97
1340 → 670	54	5mol% MgO, congruent LN

EXPERIMENTAL VALUES OF NCPM TEMPERATURE

Interacting wavelengths [μm]	T [C]	Note
SHG, o+o → e		
	25.4	0.6mol% MgO, congruent LN
	78.5	7mol% MgO, along X
1064 → 532	85–109	>5mol% MgO
	107	5mol% MgO
	110.8	7mol% MgO
1050 → 525	75.3	5mol% MgO, Li/Nb=0.97
1080 → 540	115	5mol% MgO, congruent LN

EXPERIMENTAL VALUES OF ANGULAR AND TEMPERATURE BANDWIDTHS

Interacting wavelengths [μm]	T [C]	θ _{pm} [deg]	Δθ ^m [deg]	ΔT [C]	Note
SHG, o+o → e					
	20	76	0.063		5mol% MgO
	25.4	90		0.68	0.6mol% MgO
1064 → 532	107	90	2.16	0.73	5mol% MgO
	110.6	90		0.73	5mol% MgO

VARIATION OF REFRACTIVE INDEX WITH TEMPERATURE

	T [C]	355nm	406nm	532nm	633nm	1064nm
	25	2.40179	2.39152	2.23622	2.20351	2.15714
LiNbO ₃	50	2.40343	2.32807	2.23765	2.20458	2.15757
	75	2.40722	2.33080	2.23940	2.20607	2.15884
	25	2.38482	2.31248	2.22530	2.19323	2.14757
MgO: LiNbO ₃	50	2.38778	2.31441	2.22644	2.19424	2.14861
	75	2.39152	2.31718	2.22819	2.19567	2.14966

TEMPERATURE DERIVATIVES OF REFRACTIVE INDICES FOR 5 MOL% MGO-DOPED CONGRUENT LINBO₃

λ [nm]	dn _e /dT × 10 ⁶ [K ⁻¹]	dn _o /dT × 10 ⁶ [K ⁻¹]
540	16.663	72.763
633	12.121	64.866
1080	4.356	54.190
1341	5.895	52.665

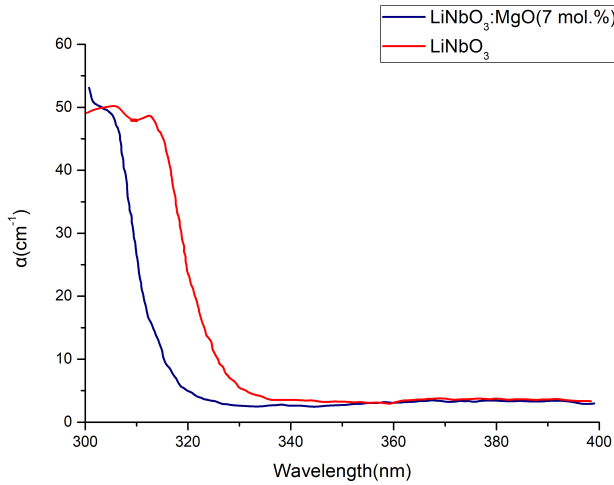
TEMPERATURE DERIVATIVES OF REFRACTIVE INDICES FOR 5 MOL% MGO-DOPED CONGRUENT LINBO₃

d ₃₁ (0.852μm) =4.9pm/V	d ₃₃ (1.064μm) =25.0pm/V
d ₃₃ (0.852μm) =28.4pm/V	d ₃₁ (1.313μm) =3.4pm/V
d ₃₁ (1.064μm) =4.4pm/V	d ₃₃ (1.313μm) =20.3pm/V

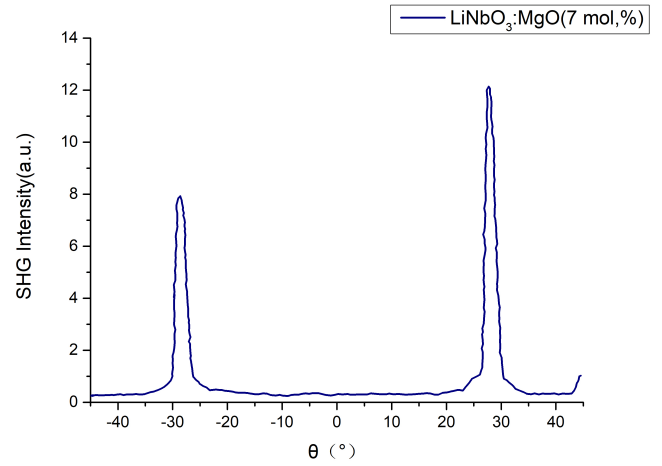


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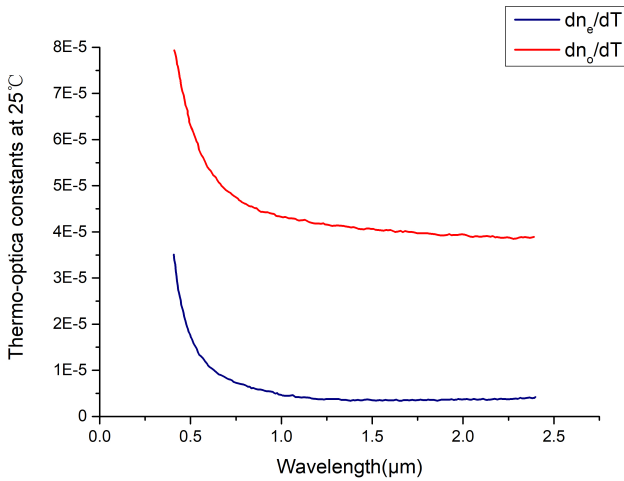
SPECTRA



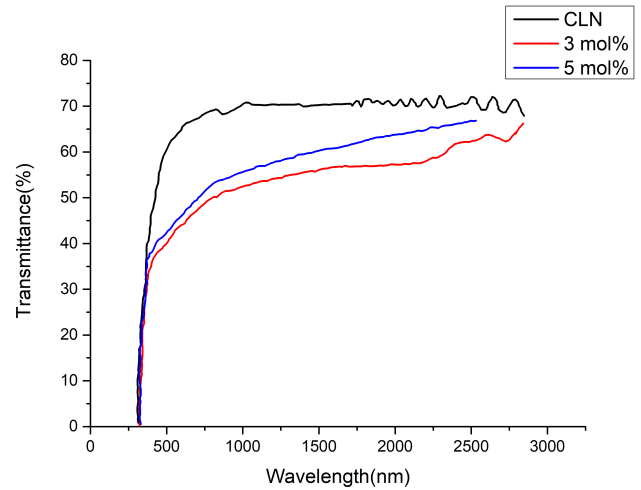
Absorption Spectra of LiNbO₃ and LiNbO₃ MgO (7 mol.%) crystals in the region of absorption edge.



Angular dependence of SHG intensity in LiNbO₃ MgO (7 mol.%) crystal with a I-type phase matching (oo-e)



Thermo-optic constants at 25 °C in the ordinary and extraordinary waves of MgO LiNbO₃



Transmission spectra of a undoped and MgO doped LN crystals.

