

SBN crystals parameters table

By Altechna

$\text{Sr}_x\text{Ba}_{1-x}\text{Nb}_2\text{O}_6$ (SBN) $0.25 \leq x \leq 0.75$

SBN belongs to ferroelectrics with tungsten bronze structure



Electro-optic coefficients

$$r_{33} = 1340 \text{ pm/V for SBN:75}$$

$$r_{33} = 235 \text{ pm/V for SBN:61}$$

SBN:75 - $\text{Sr}_{0.75}\text{Ba}_{0.25}\text{Nb}_2\text{O}_6$

SBN:61 - $\text{Sr}_{0.61}\text{Ba}_{0.39}\text{Nb}_2\text{O}_6$

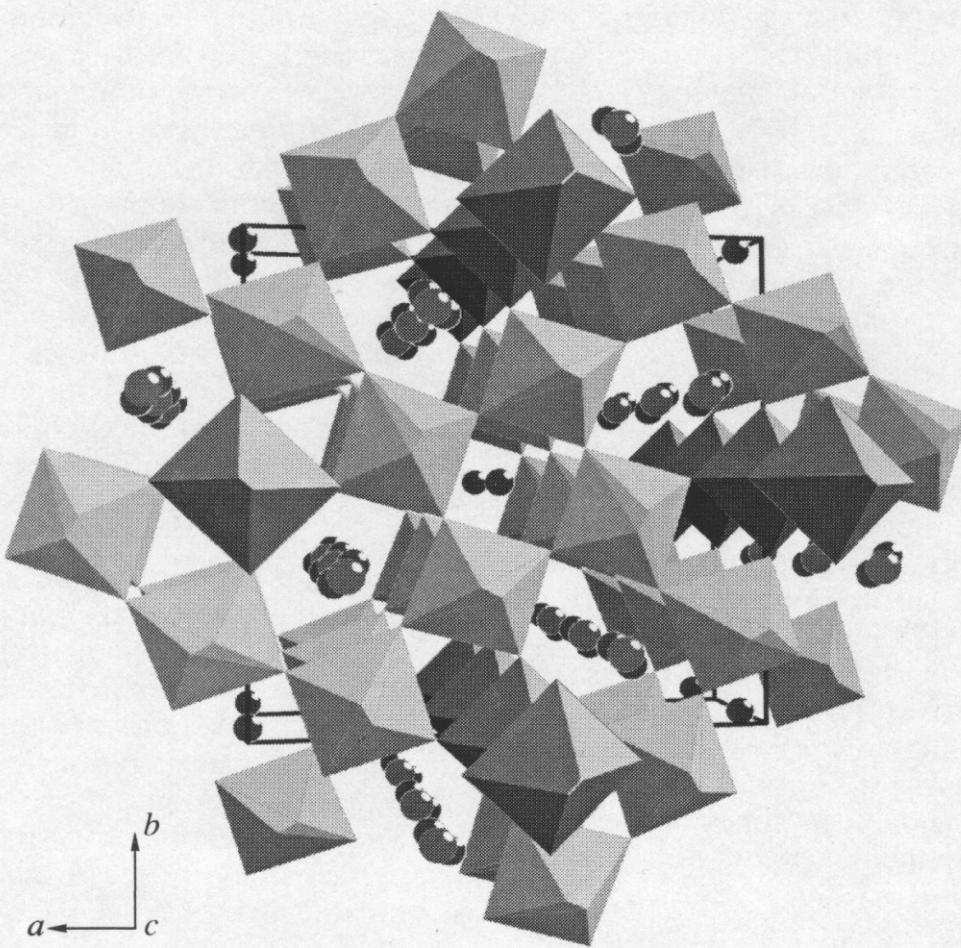
Special dopants

Ce, Cr, Co, Ni, La, Tm, Yb, Nd
Ce+La, Ce+Ti, Ce+Cr

SBN APPLICATIONS

- **Two-wave mixing:** optical information recording, dynamic holographic interferometry, optical holographic amplifier;
- **Four-wave mixing:** highly efficient phase conjugation, self pumped phase conjugation mirror, double phase conjugation mirror;
- **Electro-optical elements, acousto-optical elements**
- **Pyroelectrical detectors;**
- **Self-frequency doubling; self-sum-frequency mixing of laser and pump radiations.**

SBN crystal structure



The SBN structural formula
 $(A1)_2(A2)_4(C)_4(B1)_2(B2)_8O_{30}$

Tetragonal A1 positions represent preferable Sr ions positions.

Pentagonal A2 positions represent positions statistically occupied by Ba and Sr ions.

Trigonal positions C are vacant.

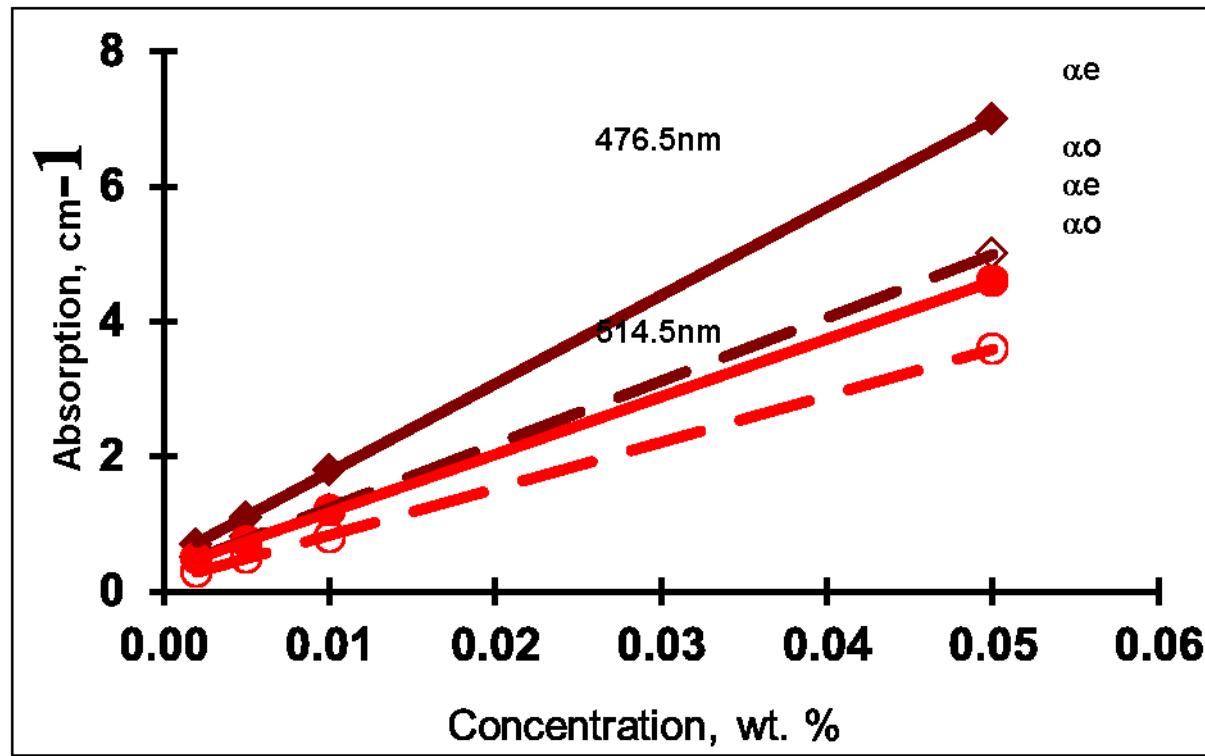
The unit cell contains ten NbO_6 octahedra (B1+B2).

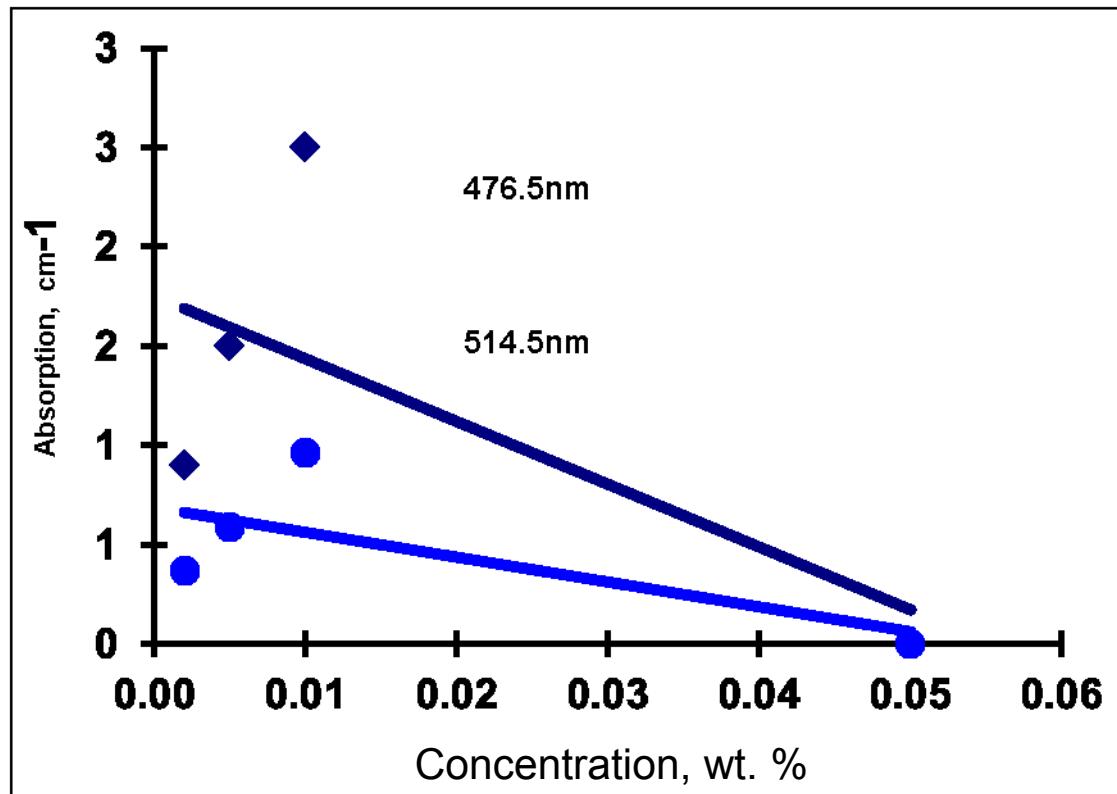
SBN profiled crystals

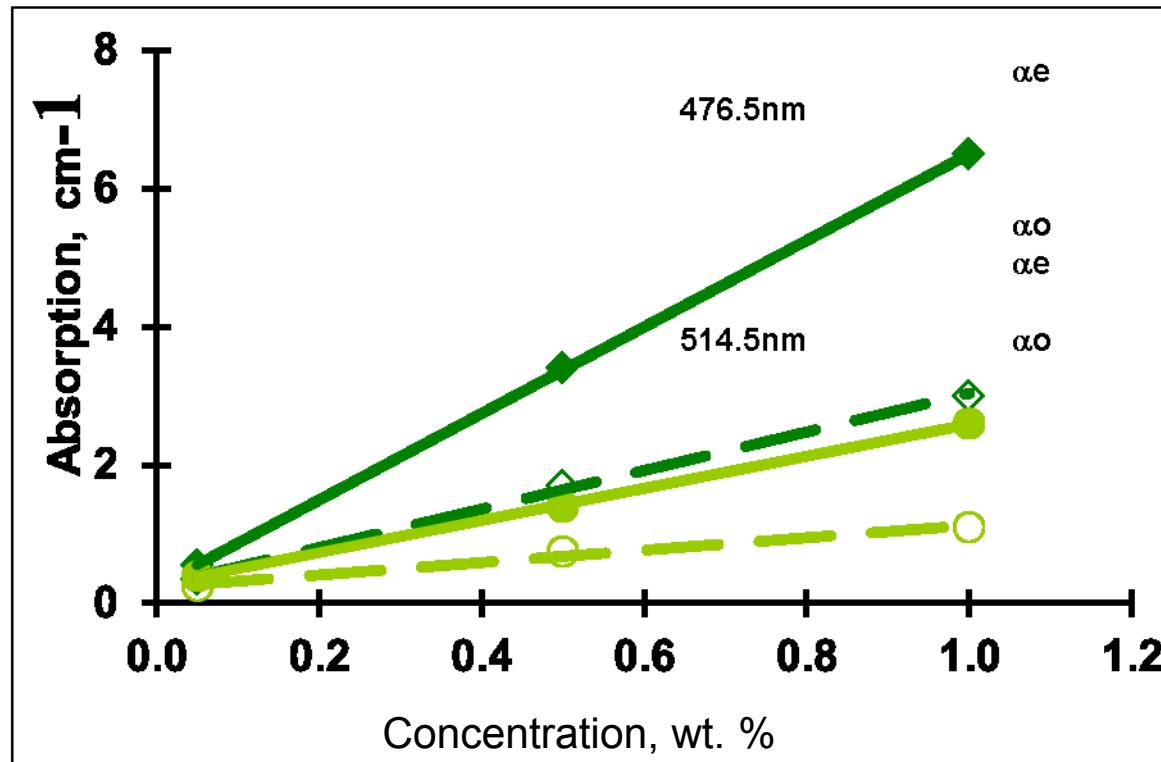


Dependencies of absorption coefficient on dopant concentration

Dopant concentration, wt. %	$\lambda=476.5\text{nm}$ α_e, cm^{-1}	α_o, cm^{-1}	$\lambda=514.5\text{nm}$ α_e, cm^{-1}	α_o, cm^{-1}
Cr ₂ O ₃				
0.002	0.9		0.4	
0.01	2.5		1.0	
Co ₃ O ₄				
0.002	0,70	0,50	0,50	0,30
0.005	1,10	0,80	0,75	0,50
0.01	1,80	1,20	1,20	0,80
0.05	7,00	5,00	4,60	3,60
Ni ₂ O ₃				
0.05	0,55	0,35	0,40	0,25
0.5	3,40	1,70	1,40	0,75
1.0	6,50	3,00	2,60	1,10







Ferroelectric parameters

Crystal	Dopant concentration in the melt, wt.%	Keff	α_e, cm^{-1} ($\lambda=488$ nm)	$T_{\max}, ^\circ\text{C}$ (1 kHz)	$\epsilon_{33, \text{RT}}$ (1 kHz)	$\epsilon_{33, T_{\max}}$ (1 kHz)	$P_s, \mu\text{k/cm}$
SBN:61	Nominally pure	-		81	930	33000	33
SBN:75	Nominally pure	-		56	5000	28000	17
SBN:61:CeO ₂	0.1	1	0.9	76	850	30000	20
SBN:61:La ₂ O ₃	1.0			61	1800		
SBN:61:La ₂ O ₃ :CeO ₂	1.0 La ₂ O ₃ 0.1 CeO ₂			as-grown 30-37 after annealing 43	as-grown 8300 after annealing 8500	as-grown 9100 after annealing 23000	
SBN:61:La ₂ O ₃ :CeO ₂	1.0 La ₂ O ₃ 0.01 CeO ₂			32-34	6000	7500	
SBN:61:Nd ₂ O ₃	0.22 0.44			69 60	2500 3100		
SBN:61:Co ₃ O ₄	0.002 0.01 0.05	0.3	0.8 1.8				
SBN:61:Cr ₂ O ₃	0.002 0.01	0.9	0.6 2.2				
SBN:61:Ni ₂ O ₃	0.05 0.5 1.0	0.25	0.4	54 40	5000 14000	22000 34000	

Note: T_{\max} is the temperature of the maximum of ϵ_{33} ; ϵ_{33} (RT) and ϵ_{33} (T_{\max}) are the dielectric constants for 1 kHz at room temperature and T_{\max} , respectively; P_s is the spontaneous polarization.

Effects of rare-earth impurities on phase-transition temperature in SBN:61

Crystals	Wt.% of impurity in the melt	At.% of impurity in the crystal bulk	T _{max} , °C (1kHz)	ΔT _{max} per 1 at.% of impurity in the bulk	ε ₃₃ , 296 K
SBN:75			40		2500
SBN:61			81		900
SBN:61:La ₂ O ₃	1.0	1.5	61	22°	1800
SBN:61:Tm ₂ O ₃	1.0	1.0	54-56	25°	2000
SBN:61:CeO ₂	0.2	0.4	72		
SBN:61:CeO ₂	0.4	0.66	57-63		2000
SBN:61:CeO ₂	0.8	1.07			
SBN:61:CeO ₂	1.6	2.1	30-32	25°	14000
SBN:61:(La ₂ O ₃ +CeO ₂)	1.0+0.1	1.4+0.22	32		
SBN:61:Yb ₂ O ₃	2.6	2.6	62	7°	2500
SBN:61:Tb ₂ O ₃	1.0		70	≤10°	

Photorefractive parameters of SBN:61

Crystal	Dopant concentration in the melt, wt. %	$U_{\lambda/2}, V$ 633nm	r_{33} , pm/V	Γ, cm^{-1}	$L_s, \mu m$	$N_{eff} 10^{17} cm^{-3}$	σ_n/σ_p	$\sigma_d 10^{-12} \Omega^{-1} cm^{-1}$	$\mu\tau_r 10^{-10} cm^2/V$
SBN:61	Nominally pure	250	245	14	2.1	0.12		9.0	0.9
SBN:61:CeO ₂	0.002	250		25					
	0.01	250		30					
	0.1	240	255	45	0.43	2.5	8.3	0.2	0.03
SBN:61:Cr ₂ O ₃	0.002	240	255	15	1.16	0.37	2.9	25.6	1.80
	0.01	240	255	19	1.02	0.48	3.2	44.7	0.88
SBN:61:Co ₃ O ₄	0.002	240	255	10	1.50	0.22	3.0	1.4	1.35
	0.01	240	255	14	1.25	0.31	3.2	4.5	0.57
	0.05 light	240	255	25	0.94	0.55	6.0	5.1	0.15
	0.05 dark	240	255	33	0.67	1.07	6.6	1.0	0.04
SBN:61:Ni ₂ O ₃	0.05	240	255	15	1.7	0.32	6.2	38	5.1
	0.5	130	475	19	2.3	0.44	5.3	206	5.7
SBN:61: Nd ₂ O ₃	0.22								
	0.44	180	340						
SBN:61:La ₂ O ₃	1.0	70	880						
SBN:61: La ₂ O ₃ +CeO ₂	La 1.0	130	475						
	Ce 0.01								
	La 1.0	60	1000	20	1.33	2.6	1.8	23.6	0.83

$U_{\lambda/2}$ – half-wave voltage; r_{33} – electrooptical coefficient; Γ – two-wave mixing gain.

L_s – Debye screening length; N_{eff} – effective concentration of carrier traps.

σ_n/σ_p – ratio of electron and hole conductivities; σ_d – dark conductivity.

$\mu\tau_r$ – product of the mobility and the recombination time of charge carriers.