28 $NaNO_2$ family

28A Pure compounds

No. 28A-1 $NaNO_2$, Sodium nitrite

(M = 69.00)

1a Ferroelectricity in $NaNO_2$ was discovered by Sawada et al. in 1958. 58Saw

b

phase	III	II *)	I	
state	F		P	
crystal system	orthorhombic	orthorhombic	orthorhombic	[a]) 31Zie
space group	Im2m– C_{2v}^{20} [a])		Immm– D_{2h}^{25} [b])	[b]) 43Str
Θ [K] [c])	437.1		438.4	[c]) 75Ema

A second order phase transition was suggested at 448 K by measurements of dc resistivity, DTA and unit cell parameters. 96Alm
P_s || [010]. 58Saw
T_{melt} = 554.2 K. 63Cle
$\rho = 2.157 \cdot 10^3$ kg m^{-3} at RT. 31Zie
Transparent, light yellowish, deliquescent.
Cleavage plane: {101}.

*) Incommensurately modulated structure was found in phase II; see subsections 3b and 14a.

2a Crystal growth: cooling from melt; evaporation or cooling of aqueous solution.
Solubility in H_2O: Table 28A-1-001.
Preferred growth and face-development of crystals grown by Czochralski method: see 89Iva
Growth and purification by zone-refining technique: see 87Yad

b Crystal form grown from aqueous solution: Fig. 28A-1-001.

3a Unit cell parameters: a = 3.560(10) Å, b = 5.563(5) Å, c = 5.384(5) Å. T = 299 K. 61Kay
Unit cell parameters at different temperatures:

phase	T [K]	a [Å]	b [Å]	c [Å]	
III	120	3.518(1)	5.535(1)	5.3282(1)	90Oku
	423	3.642(19)	5.653(20)	5.375(16)	72Kay
I	443	3.668(1)	5.669(1)	5.363(1)	88Kom
	458	3.671(12)	5.670(8)	5.341(18)	72Kay
	498	3.695(17)	5.701(30)	5.298(22)	72Kay

b Z = 2 in phases III and I. 31Zie, 43Str

Crystal structure of phases III and I: Table 28A-1-002, Table 28A-1-003; Fig. 28A-1-002, Fig. 28A-1-003;
see also 88Kom, 88Som, 90Oku

	Crystal structure of phase II: Table 28A-1-004; Fig. 28A-1-004; see also	85Yam, 85Kuc
4	Thermal expansion: Fig. 28A-1-005, Fig. 28A-1-006, Fig. 28A-1-007; see also	61Hos, 65Mar, 65Sak, 69Ges, 75Ema
5a	Dielectric constant: Fig. 28A-1-008, Fig. 28A-1-009, Fig. 28A-1-010. Dielectric dispersion: Fig. 28A-1-011, Fig. 28A-1-012. Dielectric properties of thin layer: see	81Vog, 86Ham
	Dielectric dispersion in the vicinity of the III–II–I transitions: Fig. 28A-1-013, Fig. 28A-1-014. Phase diagram with regard to p: Fig. 28A-1-015; initial pressure coefficients of transition temperatures: $[d\Theta_{III-II}/dp]_{p=0} = 4.9 \cdot 10^{-8}$ K Pa^{-1}, $[d\Theta_{II-I}/dp]_{p=0} = 5.6 \cdot 10^{-8}$ K Pa^{-1}. Effect of bias field: Fig. 28A-1-016, Fig. 28A-1-017.	65Ges2
b	$\xi = -1 \cdot 10^{11}$ V C^{-3} m^5, $\zeta = 4.8 \cdot 10^{13}$ V C^{-5} m^9.	61Nom1
c	Spontaneous polarization: Fig. 28A-1-018; pressure effect on spontaneous polarization: Fig. 28A-1-019.	
d	Pyroelectricity: see	61Saw, 81Del
6a	Heat capacity: Fig. 28A-1-020, Fig. 28A-1-021; heat capacity in the vicinity of the III–II–I transitions: Fig. 28A-1-022; heat capacity at low temperature: Fig. 28A-1-023; see also Effects of irradiation: see Fig. 28A-1-101, Fig. 28A-1-102 in subsection 16.	82Law
b	Thermal conductivity: Fig. 28A-1-024.	
7a	Piezoelectricity: Fig. 28A-1-025, Fig. 28A-1-026.	
b	Electrostriction: Fig. 28A-1-027, Fig. 28A-1-028.	
8a	Elastic compliances and stiffnesses: Table 28A-1-005; Fig. 28A-1-029, Fig. 28A-1-030, Fig. 28A-1-031, Fig. 28A-1-032; see also	70Hau, 74Shi1, 74Shi2
	Ultrasonic attenuation: Fig. 28A-1-033, Fig. 28A-1-034, Fig. 28A-1-035, Fig. 28A-1-036, Fig. 28A-1-037; see also	80Esa, 81Esa, 86HuJ
9a	Refractive indices: Fig. 28A-1-038; infrared refractive indices: Table 28A-1-006. Birefringence: Fig. 28A-1-039, Fig. 28A-1-040. Optical absorption in visible-ultraviolet region: Fig. 28A-1-041; infrared absorption: Fig. 28A-1-042, Fig. 28A-1-043, Fig. 28A-1-044, Fig. 28A-1-045; see also	82Bre, 85Bre, 85Koz

b	Electrooptic effect: Fig. 28A-1-046. Electrooptic constants: $r_{42} = -3.0(2) \cdot 10^{-12}$ m V^{-1}, $r_{51} = -1.9(2) \cdot 10^{-12}$ m V^{-1}. $\lambda = 546$ nm.	69Joh
c	Piezooptic effect: Table 28A-1-007; see also	72Hau
d	Optical rotatory power: Fig. 28A-1-047.	
e	Nonlinear optical properties: Fig. 28A-048; see also	70Vog, 70Yan, 72Ino
10a	Raman scattering: Table 28A-1-008, Table 28A-1-009; Fig. 28A-1-049, Fig. 28A-1-050, Fig. 28A-1-051, Fig. 28A-1-052, Fig. 28A-1-053. Pressure effect of Raman scattering: Fig. 28A-1-054, Fig. 28A-1-055, Fig. 28A-1-056; see also	81Ada
b	Brillouin scattering: Fig. 28A-1-057, Fig. 28A-1-058; see also	70Hau, 74Shi1, 74Shi2
11	Electrical conduction: Table 28A-1-010, Fig. 28A-1-059; Fig. 28A-1-060; see also	67Tak
	Electrical breakdown strength: Fig. 28A-1-061. Luminescence: see	81Han
13a	NMR, NQR: Fig. 28A-1-062, Fig. 28A-1-063, Fig. 28A-1-064, Fig. 28A-1-065, Fig. 28A-1-066, Fig. 28A-1-067, Fig. 28A-1-068, Fig. 28A-1-069, Fig. 28A-1-070, Fig. 28A-1-071, Fig. 28A-1-072, Fig. 28A-1-073, Fig. 28A-1-074, Fig. 28A-1-075, Fig. 28A-1-076, Fig. 28A-1-077; see also	74Ser, 74Sin, 75Kan, 76Pet, 81Cho 83Kan, 83Pan, 85Cho, 85Kan, 86Tow, 86Tre, 91Han, 92Iga
	NQR of irradiated crystal: see Fig. 28A-1-098, Fig. 28A-1-099, Fig. 28A-1-100 in subsection 16.	
b	ESR: Zero field parameters of NO_2: $D = 0.444(5) \cdot 10^2$ m^{-1}, $E = -0.045(5) \cdot 10^2$ m^{-1}, $g = 2.002(3)$; see also	73Die 76Die
	ESR of Mn^{2+} doped crystal: see	71Pan, 72Upr, 78Jai, 81Jai, 82Got

	ESR of irradiated crystal: see	61Zel, 64Tat, 69Luz, 69Gre
14a	X-ray and neutron diffraction due to structural modulation in phase II: Fig. 28A-1-078, Fig. 28A-1-079; effect of electric field on the modulated structure in phase II: Fig. 28A-1-080, Fig. 28A-1-081, Fig. 28A-1-082; see also	67Hos, 83Dur
b	Diffuse scattering: Fig. 28A-1-083, Fig. 28A-1-084, Fig. 28A-1-085, Fig. 28A-1-086, Fig. 28A-1-087, Fig. 28A-1-088; see also	64Can, 82Dur
	Critical scattering: Fig. 28A-1-089, Fig. 28A-1-090. Inelastic scattering: Fig. 28A-1-091, Fig. 28A-1-092, Fig. 28A-1-093.	
15a	Domain structure: Fig. 28A-1-094; domains observed by etching method. Etchant: ethanol containing NaOH [a]) or ethanol containing small amount of $CaCl_2$ [b]); see also	[a]) 69Saw [b]) 88Ant 61Nom2, 69Saw, 70Mor
	Observation by nematic liquid crystal (NLC) method: see	90Hat, 90Gal
	Observation by X-ray topography: see	66Suz, 71Suz, 72Suz, 80Suz, 81Suz, 85Tok, 94Tak
	Observation by SEM: see	87Iva
	Observation by laser scanning microscope: see	93Kru
	Relation between domain structure and dislocations: see	69Saw, 88Ant
b	Domain switching: Fig. 28A-1-095, Fig. 28A-1-096; see also	77Izu, 81Cha 85Kom, 87Iva, 90Gal, 90Hat, 92Mat, 93Kru, 95Ham1, 95Ham2, 96Ham, 96Zha
16	State density on p-Si/$NaNO_2$ interface: see	89Sch
	Isotope effect on Θ_f: no appreciable change of Θ_f was observed by ^{14}N and ^{15}N substituted $NaNO_2$.	92Hid
	Twin structure: Fig. 28A-1-097.	
	Whiskers: grown along [010] from aqueous solution.	67Ued

Etch pits: see	67Saw, 69Saw, 88Ant
Plasticity: see	66Tak, 83Nik, 85Nik, 93Smi
Radiation damage: Fig. 28A-1-098, Fig. 28A-1-099, Fig. 28A-1-100, Fig. 28A-1-101, Fig. 28A-1-102; see also	64Ges, 79Jum