

No. 31A-2 $\text{NaH}_3(\text{SeO}_3)_2$, Sodium trihydrogen selenite $(M = 279.93; [D: 282.95])$

1a	Ferroelectric activity of NaH ₃ (SeO ₃) ₂ was discovered by Pepinsky et al. in 1959.				59Pep1	
b	phase	III' ^{d)}	III ^{b)}	II ^{a)}	I ^{a)}	^{a)} 59Pep1
	state		F ^{b)}	F ^{a)}	P ^{a)}	^{b)} 64Mit
	crystal system			triclinic ^{c)}	monoclinic ^{c)}	^{c)} 59Pep2
	space group			P1–C ₁ ¹ ^{c)}	P2 ₁ /a–C _{2h} ⁵ ^{c)}	^{d)} 86Bon
	Θ [°C]	–189 ^{d)} –162 ^{*)} –79 ^{a)}				
	For the deuterated crystal, Θ _{II–I} = –3.5 °C.					65Bli
	The spontaneous polarization of NaH ₃ (SeO ₃) ₂ has a large component along the <i>a</i> axis in phases II and III.					65Bli, 67Shu
	ρ = 3.20(1) · 10 ³ kg m ^{–3} .					68Vij
	Phase diagram of Na(H _{1–x} D _x) ₃ (SeO ₃) ₂ : Fig. 31A-2-001; see also					72Shu
	Transparent, colorless.					
	Phase III is electrically uniaxial.					67Shu
	*) III–II phase transition has thermal hysteresis of about 10 °C.					
2a	Crystal growth: slow cooling or evaporation of aqueous solution of sodium hydroxide or sodium carbonate and selenious acid in stoichiometric proportions.					67Cev
b	Crystal form: Fig. 31A-2-002.					
3a	Unit cell parameters: <i>a</i> = 11.77 Å, <i>b</i> = 4.84 Å, <i>c</i> = 5.80 Å, β = 118.5° at RT.					59Pep2
	For the deuterated crystal: <i>a</i> = 11.794(10) Å, <i>b</i> = 4.844(5) Å <i>c</i> = 5.787(5) Å, β = 118.4(10)° at RT.					72Moh
	Kaplan et al. selected another axial system: <i>a</i> ' = 10.3450(4) Å, <i>b</i> ' = 4.8440(2) Å, <i>c</i> ' = 5.7866(2) Å, β' = 91.133(4)° at RT. <i>a</i> ' = <i>a</i> + <i>c</i> , <i>b</i> ' = – <i>b</i> , <i>c</i> ' = – <i>c</i> .					70Kap
	Vijayan et al. selected another axial system: <i>a</i> '' = <i>a</i> + <i>c</i> , <i>b</i> '' = <i>b</i> , <i>c</i> '' = <i>c</i> , β'' = 180° – β'.					68Vij
	Unit cell parameters: Table 31A-2-001.					
b	Z = 2 in phase I.					70Kap
	Crystal structure: Table 31A-2-002, Table 31A-2-003, Table 31A-2-004, Table 31A-2-005; Fig. 31A-2-003, Fig. 31A-2-004, Fig. 31A-2-005.					
4	Lattice distortions: Fig. 31A-2-006, Fig. 31A-2-007, Fig. 31A-2-008.					
5a	Dielectric constant: Fig. 31A-2-009, Fig. 31A-2-010, Fig. 31A-2-011, Fig. 31A-2-012, Fig. 31A-2-013, Fig. 31A-2-014, Fig. 31A-2-015; see also					78Lut
	Pressure effect on Θ: Table 31A-2-006.					
	dΘ _{II–I} /dp = –1.24(7) · 10 ^{–8} K Pa ^{–1} .					74Sor
	For NaD ₃ (SeO ₃) ₂ , dΘ/dp = –3.3 · 10 ^{–8} K Pa ^{–1} .					66Sam
b	Nonlinear dielectric properties: Fig. 31A-2-016.					
	<i>E</i> = (ε ₀ <i>C</i>) ^{–1} (<i>T</i> –Θ _p) <i>P</i> + ζ <i>P</i> ³ + ζ <i>P</i> ⁵					70Bli
	<i>C</i> = 1.6 · 10 ³ K, ζ = –1.9 · 10 ¹⁰ Vm ⁵ C ^{–3} , ζ = 9.0 · 10 ¹³ Vm ⁹ C ^{–5} .					70Bli
c	Spontaneous polarization: Fig. 31A-2-017, Fig. 31A-2-018, Fig. 31A-2-019.					

6a Heat capacity: Fig. 31A-2-020. Transition heat, transition entropy:				64Mit
	III–II	II–I		
ΔQ_m	≈ 196	794	J mol^{-1}	
ΔS_m	≈ 2.1	4.1	$\text{J K}^{-1} \text{mol}^{-1}$	
7a Piezoelectricity: Table 31A-2-007; Fig. 31A-2-021, Fig. 31A-2-022.				
8a Elastic compliance and stiffnesses: Fig. 31A-2-015, Fig. 31A-2-023, Fig. 31A-2-024.				
9a Reflection: Fig. 31A-2-025. Infrared absorption: Table 31A-2-008; Fig. 31A-2-026. Optical indicatrix: see Fig. 31A-3-023 in No. 31A-3.				
d Optical activity: Fig. 31A-2-027.				
10a Raman scattering: Table 31A-2-009; Fig. 31A-2-028, Fig. 31A-2-029, Fig. 31A-2-030.				
b Brillouin scattering: Fig. 31A-2-031.				
11 For both crystals of $\text{NaH}_3(\text{SeO}_3)_2$ and $\text{NaD}_3(\text{SeO}_3)_2$: Conductivity: $\sigma \approx 10^{-7} \Omega^{-1} \text{m}^{-1}$ at RT. Activation energy: $\Delta U = 0.74 \dots 0.83 \text{ eV}$.				67Kni 67Kni
13a NMR: Table 31A-2-009, Table 31A-2-010, Table 31A-2-011, Table 31A-2-012, Table 31A-2-013, Table 31A-2-014, Table 31A-2-015; Fig. 31A-2-032, Fig. 31A-2-033, Fig. 31A-2-034, Fig. 31A-2-035, Fig. 31A-2-036. For ^{23}Na NMR, see For T_1 , see Proton spin lattice relaxation time for γ -ray irradiated specimens: see In the ferroelectric phase of $\text{NaD}_3(\text{SeO}_3)_2$, there are two nonequivalent Na sites.				77Ale 76Mal 71Lav 78Kas
b ESR: Fig. 31A-2-037.				
14 Bragg reflection: Fig. 31A-2-038, Fig. 31A-2-039, Fig. 31A-2-040, Fig. 31A-2-041, Fig. 31A-2-042, Fig. 31A-2-043.				
15a Domain structure: change in domain structure induced by electric field and mechanical stress.				75Shu, 87Kly, 89Iva