

34 PbHPO₄ family

34A Pure compounds

No. 34A-1 PbHPO₄, Lead hydrogen phosphate (Lead monetite)

(*M* = 303.2; [D: 304.2])

1a	Ferroelectricity in PbHPO ₄ was discovered by Negran et al. in 1974.		74Neg	
b	phase	II	I	
	state	F	P	
	crystal system	monoclinic	monoclinic	
	space group	Pc–C _s ^{2a)}	P2/c–C _{2h} ^{4b)}	a) 76Are
	Θ [K]	310 [D: 452] ^{b)}		b) 74Neg
	P _s makes an angle 22(5)° to the [100] direction in the (010) plane, see Fig. 34A-1-002.			74Neg
	Decomposing temperature: 770 K.			88Des
	Transparent, colorless. Cleavage plane: (100).			88Des
2a	Crystal growth: evaporation of aqueous solution; growth from gel.			74Neg 76Bre, 88Des
	Solubility in acidified H ₂ O: Fig. 34A-1-001.			
b	Crystal form: Fig. 34A-1-002.			
3a	Unit cell parameters of PbHPO ₄ : <i>a</i> = 4.6829(2) Å, <i>b</i> = 6.6447(2) Å, <i>c</i> = 5.7798(2) Å, β = 97.150(3)°, <i>T</i> = 316 K. For PbDPO ₄ : <i>a</i> = 4.6855(5) Å, <i>b</i> = 6.6911(7) Å, <i>c</i> = 5.7867(8) Å, β = 97.10(1)°, <i>T</i> = RT.			87Tun 74Neg
b	<i>Z</i> = 2 in phases I and II. Crystal structure: Table 34A-1-001, Table 34A-1-002; Fig. 34A-1-003.			74Neg
4	Thermal expansion: Table 34A-1-003; Fig. 34A-1-004, Fig. 34A-1-005, Fig. 34A-1-006. Pressure dependence of unit cell parameters: Table 34A-1-004; Fig. 34A-1-007.			
5a	Dielectric constant: Fig. 34A-1-008, Fig. 34A-1-009, Fig. 34A-1-010, Fig. 34A-1-011, Fig. 34A-1-012. Effect of hydrostatic pressure: dΘ _{I–I} /d <i>p</i> = –115 · 10 ^{–9} K Pa ^{–1} ; see also Dielectric dispersion: Fig. 34A-1-013, Fig. 34A-1-014, Fig. 34A-1-015; see also Dielectric constant in millimeter-wave region: Fig. 34A-1-016, Fig. 34A-1-017.			79Myl 78Yas 92Miz
b	Effect of bias field: Fig. 34A-1-018, Fig. 34A-1-019. <i>E</i> = (1/χ _p) <i>P</i> + ξ <i>P</i> ³ with ξ = 7.7 · 10 ¹² [D: 1.3 · 10 ¹⁴] V m ⁵ C ^{–3} .			74Neg
c	Spontaneous polarization: Fig. 34A-1-020, Fig. 34A-1-021.			
6a	Heat capacity: Fig. 34A-1-022. Transition heat and transition entropy for II–I transition: Δ <i>Q</i> _m = 265(1) J mol ^{–1} , Δ <i>S</i> _m = 0.93(3) J mol ^{–1} K ^{–1} .			81Lop

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8a	Ultrasonic velocity and attenuation: Fig. 34A-1-023, Fig. 34A-1-024; see also	94Val
9a	Optical data: $\Delta n_{\gamma\beta} = 0.0725(30)$, $\Delta n_{\beta\alpha} = 0.008$, $2V = 38(2)^\circ$, $\lambda = 633$ nm. Refractive indices: Fig. 34A-1-025 Fig. 34A-1-026, Fig. 34A-1-027. Photo stimulated luminescence: see Infrared absorption: Fig. 34A-1-028; see also Table 34A-1-006, Table 34A-1-007 in 10a and e Nonlinear optical properties: Table 34A-1-005; Fig. 34A-1-029.	77Kon 87Bau 80Koc
10a	Raman scattering: lattice mode frequencies of PbHPO ₄ : Table 34A-1-006, Table 34A-1-007; Fig. 34A-1-030, Fig. 34A-1-031. Soft mode frequency: Fig. 34A-1-032. Lattice mode frequencies of PbDPO ₄ : Fig. 34A-1-033, Fig. 34A-1-034. Internal PO ₄ mode frequencies of PbDPO ₄ : Fig. 34A-1-035, Fig. 34A-1-036. Hyper-Raman scattering: Fig. 34A-1-037; see also Table 34A-1-006, Table 34A-1-007.	
b	Brillouin scattering: Fig. 34A-1-038, Fig. 34A-1-039, Fig. 34A-1-040; see also	95Kuo
12	Magnetic susceptibility: $\chi_{\text{magn } \rho} = 9.51 \cdot 10^{-11} \text{ m}^3 \text{ kg}^{-1}$, $T = \text{RT}$.	88Des
13a	NMR: Table 34A-1-008, Fig. 34A-1-041; see also NQR: Fig. 34A-1-042.	89Erm
14b	Inelastic neutron scattering: see	95Pas
15	Domain structures were observed by scanning electron microscope, and by etching method. Etch pits due to dislocations were observed by using dilute nitric acid or dilute hydrochloric acid as the etchant.	81Leb 83Nak 83Nak, 90Des