No. 33A-2 RbH_2PO_4, Rubidium dihydrogen phosphate (RDP)

(M = 182.46; [D: 184.47])

1a Ferroelectric phase transition in tetragonal RbH_2PO_4 was first reported by Baertschi et al. in 1945. 45Bae

RbD_2PO_4 crystallizes in a monoclinic form at RT. Antiferroelectric or nearly antiferroelectric activity in monoclinic RbD_2PO_4 was observed by Sumita et al. in 1981. 81Sum

b

phase	IV	III	II	I	45Bae
state	F	P			
crystal system	orthorhombic	tetragonal	monoclinic [a] [b]		[a] 69Bli1
space group	$Fdd2-C_{2v}^{19}$	$I\bar{4}2d-D_{2d}^{12}$	$P2_1-C_2^2$		[b] 72Gru
Θ [°C]	−126 [D: −55]	86 [a] [b] 86...111 [d]	175 [b] 280 [c]		[c] 78Rap [d] 78Met

Phase I was reported to exist between 175 °C and T_{melt} [b].
See the phase diagram Fig. 33A-2-001.
Phase II is metastable at RT, and can be brought to RT by cooling the crystal from above Θ_{III-II}.
Different values of Θ_f were reported: Θ_f = 137 K [e], 140.4 K [f], 146.6 K [g]. [e] 68Lud [f] 73Pee [g] 71Gla

$P_s \parallel [001]$ in phase IV. 45Bae
$\rho_X = 2.765 \cdot 10^3$ kg m^{-3}. 85Ave
Transparent, colorless.

Monoclinic RbD_2PO_4:

phase	III′	II′	I′	81Sum
state	(A)	P	P	
crystal system	monoclinic	monoclinic	monoclinic	
space group	$P2_1-C_2^2$ [h]	$P2_1/c-C_{2h}^5$ [i]	$P2_1/m-C_{2h}^2$ [h]	[h] 83Suz
Θ [°C]	44	104		[i] 84Hag

Pyroelectric activity and triple dielectric hysteresis loop was observed in phase III′ 83Osa
Phase diagram of $RbD_{2(1-x)}H_{2x}PO_4$: Fig. 33A-2-002.
Phase diagram of RbD_2PO_4: see Fig. 33A-2-028 in 5a and Fig. 33A-2-049 in 8a.
$\rho_X = 2.861 \cdot 10^3$ kg m^{-3} at 332 K. 84Hag

2a Crystal growth: evaporation from aqueous solution. 45Bae
Monoclinic form of RbD_2PO_4 is grown by slow evaporation from D_2O solution. 83Ges

3a Unit cell parameters of tetragonal RbH_2PO_4
at RT: a = 7.622(7) Å, c = 7.315(9) Å. 78AlK
a = 7.607(2) Å, c = 7.299(3) Å. 80Ken
at Θ_f + 5 K: a = 7.586(3) Å, c = 7.254(4) Å. 80Ken
at 77 K (orthorhombic cell): a = 10.800(2) Å, b = 10.672(2) Å, c = 7.242(1) Å. 80Ken
at Θ_f – 5 K (orthorhombic cell): a = 10.696(2) Å, b = 10.794(2) Å, c = 7.260(2) Å. 90Fuk
See also Table 33A-1-003, Table 33A-1-004 in No. 33A-1.
c/a vs. radii of metallic ions: see Fig. 33A-11-002 in No. 33A-11.

	Unit cell parameters of monoclinic RbD_2PO_4	
	at 332 K: a = 7.683(1) Å, b = 6.170(1) Å, c = 9.560(1) Å, β = 109.10(1)°.	84Hag
	at RT: a = 15.352(2) Å, b = 6.184(1) Å, c = 9.566(2) Å, β = 108.8(1)°.	83Suz
	Unit cell parameters of monoclinic RbH_2PO_4 at 293 K: a = 9.606(5) Å, b = 6.236(5) Å, c = 7.738(5) Å, β = 109.07(5)°.	85Ave
b	Crystal structure of tetragonal and orthorhombic RbH_2PO_4:	
	Z = 4 in the $I\bar{4}2d$ cell.	45Bae
	Table 33A-2-001, Table 33A-2-002, Table 33A-2-003, Table 33A-2-004, Table 33A-2-005, Table 33A-2-006, Table 33A-2-007, Table 33A-2-008.	
	Crystal structure of tetragonal $RbH_{2(1-x)}D_{2x}PO_4$:	
	for x = 0.55, see	82Tib
	for x = 0.76, see	79Rus
	Temperature parameter: see Fig. 33A-1-015 in No. 33A-1.	
	Crystal structure of monoclinic RbD_2PO_4:	
	Z = 4 in phase II′.	84Hag
	Z = 8 in phase III′.	83Suz
	Table 33A-2-009, Table 33A-2-010, Table 33A-2-011, Table 33A-2-012; Fig. 33A-2-003, Fig. 33A-2-004.	
	Crystal structure of monoclinic RbH_2PO_4: Z = 4 at RT (metastable phase II).	85Ave
	Table 33A-2-013, Table 33A-2-014, Table 33A-2-015; Fig. 33A-2-005.	
4	Thermal expansion of monoclinic RbD_2PO_4: Fig. 33A-2-006.	
5a	Dielectric constant κ_c vs. T in tetragonal RbH_2PO_4:	
	Fig. 33A-2-007, Fig. 33A-2-008, Fig. 33A-2-009, Fig. 33A-2-010, Fig. 33A-2-011.	
	Curie-Weiss law, $\kappa_c = C/(T - \Theta_p)$ for $T > \Theta_p$, where $C = 3.430(15) \cdot 10^3$ K and Θ_p = 141.4(2) K.	73Pee
	κ_c vs. T under p: Fig. 33A-2-012; see also Fig. 33A-2-007 and	70Fre
	κ_c, C vs. p: Fig. 33A-2-013, Fig. 33A-2-014.	
	$\kappa_c = C^*/(p - p_0)$; $C^* = 1530(5) \cdot 10^8$ Pa and $p_0 = 0.24 \cdot 10^8$ Pa at 140 K.	73Pee
	κ and $\tan\delta$ for several frequencies: see	65Zhe
	Θ_f vs. p: Fig. 33A-2-015;	
	see Fig. 33A-2-001 in 1b and also Table 33A-1-030 in No. 33A-1.	
	κ_b, κ_b^{-1} vs. T of monoclinic $RbD_{2(1-x)}H_{2x}PO_4$: Fig. 33A-2-016, Fig. 33A-2-017.	
	Pressure effect on κ_b vs. T of monoclinic RbD_2PO_4: Fig. 33A-2-018, Fig. 33A-2-019.	
	κ_b vs. p: Fig. 33A-2-020.	
	Pressure effect on κ_c vs. T of tetragonal RbD_2PO_4: Fig. 33A-2-021.	
	κ_b' and κ_b'' vs. f and T in monoclinic RbD_2PO_4: Fig. 33A-2-022, Fig. 33A-2-023, Fig. 33A-2-024; see also	85Kom
	κ', κ'' vs. T in far-infrared region: Fig. 33A-2-025.	
	κ', κ'' in vacuum ultraviolet and far-infrared regions: see also Fig. 33A-2-051, Fig. 33A-2-054 in 9a.	
	Θ_f vs. p of tetragonal RbD_2PO_4: Fig. 33A-2-026.	
	Phase diagram in regard to E_{bias} and p of monoclinic RbD_2PO_4: Fig. 33A-2-027, Fig. 33A-2-028.	
b	Nonlinear dielectric properties: see Tab. 33A-1-031 in No. 33A-1;	
	see also	74Zhe, 81Pes1, 81Tro
c	P_s vs. T: Fig. 33A-2-029.	
	Effect of E_{bias} on P_3: Fig. 33A-2-030.	
	Sublattice polarization of monoclinic RbD_2PO_4: Fig. 33A-2-031.	

	Effect of hydrostatic pressure on P_s in tetragonal RbH_2PO_4: see Fig. 33A-1-101 in No. 33A-1.	
	Critical field of double D–E hysteresis loop in monoclinic RbD_2PO_4: Fig. 33A-2-032.	
6a	Heat capacity: Fig. 33A-2-033.	
	DSC of the III → II transition: see	78Met
7a	Piezoelectricity: Fig. 33A-2-034.	
	$d_{14} = 3.0 \cdot 10^{-12}$ C N^{-1}, $d_{36} = 26.7 \cdot 10^{-12}$ C N^{-1} at 25 °C.	69Adh1
	See also	49Jaf
8a	Elastic compliance and stiffness in tetragonal RbH_2PO_4: Table 33A-2-016; Fig. 33A-2-035, Fig. 33A-2-036, Fig. 33A-2-037.	
	c_{66} obtained from Brillouin scattering: Fig. 33A-2-038.	
	Effect of p on $c_{\lambda\lambda}$: Fig. 33A-2-039.	
	Ultrasonic velocity and absorption: Fig. 33A-2-040, Fig. 33A-2-041, Fig. 33A-2-042, Fig. 33A-2-043, Fig. 33A-2-044.	
	Effect of p on ultrasonic velocity: Fig. 33A-2-045, Fig. 33A-2-046, Fig. 33A-2-047, Fig. 33A-2-048.	
	p–T phase diagram determined by elastic wave velocity: Fig. 33A-2-049.	
9a	Refractive indices: Table 33A-2-017, Table 33A-2-018, Table 33A-2-019; Fig. 33A-2-050; see also	76Vol
	Parameters in Sellmeier equations: see Table 33A-1-040, Table 33A-1-041 in No. 33A-1.	
	κ', κ'' in vacuum ultraviolet region: Fig. 33A-2-051; see also Fig. 33A-1-153 in No. 33A-1.	
	Transmission in visible and infrared regions: Fig. 33A-2-052.	
	Optical absorption: Fig. 33A-2-053; see also Table 33A-1-043 in No. 33A-1.	
	Far-infrared absorption: Fig. 33A-2-054, Fig. 33A-2-055.	
	$\partial n/\partial T$ for several λ: see Table 33A-1-042 in No. 33A-1.	
b	Electrooptic effect: Table 33A-2-020; see Table 33A-1-048; Fig. 33A-1-185, Fig. 33A-1-187 in No. 33A-1 and also	69Adh2
	Effect of E_{bias} on birefringence: Fig. 33A-2-056, Fig. 33A-2-057.	
	The sign of r_{36} is negative: see	81Pes2
c	Piezooptic constant:	
	$p_{11} = 0.273$, $p_{12} = 0.240$, $p_{13} = 0.218$, $p_{31} = 0.210$, $p_{33} = 0.208$ for $\lambda = 632.8$ nm [a]) and $p_{66} = 0.032$ [b]).	[a]) 77Ale [b]) 69Vas
	p_{66} obtained from Brillouin scattering: Fig. 33A-2-058, Fig. 33A-2-059; see also Table 33A-1-051 and Fig. 33A-1-190 in No. 33A-1.	
d	Gyration tensor component: Fig. 33A-2-060.	
	Quadratic electrogyration coefficient: see Fig. 33A-1-202 in No. 33A-1.	
	Verdet constant: see Fig. 33A-8-006 in No. 33A-8.	
e	Nonlinear susceptibility for SHG:	
	$d_{14} = 0.39(4) \cdot 10^{-12}$ m V^{-1}, $d_{36} = 0.41(5) \cdot 10^{-12}$ m V^{-1} for $\lambda = 1.06$ µm;	74Kat
	see also	77Nik
	Induced birefringence: see Fig. 33A-1-149 in No. 33A-1.	
	Optical rectification properties: see	80Mor
10a	Raman scattering: Fig. 33A-2-061, Fig. 33A-2-062, Fig. 33A-2-063, Fig. 33A-2-064, Fig. 33A-2-065, Fig. 33A-2-066;	
	see also Fig. 33A-1-214 in No. 33A-1 and	73Ham

b	Photoelastic constant obtained by Brillouin scattering: see Fig. 33A-2-058, Fig. 33A-2-059 in 9c. Elastic stiffness obtained by Brillouin scattering: see Fig. 33A-2-038 in 8a.	
11	Conductivity change in regard to the high temperature phase transition III–II: see	78Sha, 89Bar
13a	NMR and NQR of tetragonal form: Table 33A-2-021; Fig. 33A-2-067, Fig. 33A-2-068, Fig. 33A-2-069, Fig. 33A-2-070, Fig. 33A-2-071, Fig. 33A-2-072, Fig. 33A-2-073, Fig. 33A-2-074. NMR of RbH_2PO_4:NH_4^+: see NMR and NQR of monoclinic form: Table 33A-2-022; Fig. 33A-2-075, Fig. 33A-2-076, Fig. 33A-2-077, Fig. 33A-2-078.	 74Bli
b	ESR of SeO_4^{3-} and Tl^{2+} center: Table 33A-2-023; Fig. 33A-2-079, Fig. 33A-2-080, Fig. 33A-2-081. See Fig. 33A-1-259 and Fig. 33A-1-260 in No. 33A-1; and also	 83Bog, 84Ste
14a	Superlattice reflection: Fig. 33A-2-082.	
b	Neutron incoherent inelastic scattering: Fig. 33B-5-075 in No. 33B-5.	
15a	Domain structure: stripe domains parallel to the tetragonal (100) and (010) plane were observed by polarized light and γ-ray diffractometry.	71Gla, 78Bas
16	Internal friction measured at about 1 Hz: see	78Gri