

**No. 33A-9 CsH<sub>2</sub>AsO<sub>4</sub>, Cesium dihydrogen arsenate (CDA)**

(M = 273.84; [D: 275.85])

1a	Ferroelectricity of CsH <sub>2</sub> AsO <sub>4</sub> was first reported by Frazer et al. in 1953.				53Fra
b	phase	III	II	I	53Fra
	state	F	P		
	crystal system		tetragonal	(monoclinic) <sup>a)</sup>	a) 77Gof
	Θ [°C]	-130 [D: -61]		160(5) (on heating) <sup>a)</sup> 140(5) (on cooling) <sup>a)</sup>	
	Space group of CsH <sub>2(1-x)</sub> D <sub>2x</sub> AsO <sub>4</sub> (x = 0.85): $\bar{1}42d - D_{2d}^{12}$ at RT.				76Loi
	Θ <sub>f</sub> of CsH <sub>2(1-x)</sub> D <sub>2x</sub> AsO <sub>4</sub> : Θ <sub>f</sub> = (140.0 + 101x) K.				75Loi
	P <sub>s</sub>    [001]				53Ste
	ρ = 3.644 · 10 <sup>3</sup> kg m <sup>-3</sup> for Cs(H <sub>0.14</sub> D <sub>0.86</sub> ) <sub>2</sub> AsO <sub>4</sub> .				77Loi
	Transparent, colorless.				53Ste
2a	Crystal growth: see				75Loi, 77Loi
3a	Unit cell parameters of CsH <sub>2(1-x)</sub> D <sub>2x</sub> AsO <sub>4</sub> (x = 0.85): a = 7.985(4) Å, c = 7.896(4) Å at RT. CsH <sub>2(1-x)</sub> D <sub>2x</sub> AsO <sub>4</sub> (x = 0.95): a = 7.99(1) Å, c = 7.88(1) Å at Θ <sub>f</sub> + 5K (Θ <sub>f</sub> = 203 K). Deuterated CDA (Θ <sub>f</sub> = 205 K): a = 7.985(3) Å, c = 7.893 Å at RT; a = 7.982(7) Å, c = 7.889(9) Å at Θ <sub>f</sub> + 5K; a = 11.516(5) Å, b = 11.103(5) Å, c = 7.87(2) Å at 77 K. See also Table 33A-1-003, Table 33A-1-004 in No. 33A-1.				76Loi 76Hay 81Hay
b	c/a vs. radii of metal ions: see Fig. 33A-11-002 in No. 33A-11. Crystal structure: Table 33A-9-001, Table 33A-9-002. Deuterium bond: Table 33A-9-003. Temperature parameters: Fig. 33A-9-001; see also Fig. 33A-1-015 in No. 33A-1. Comparison of the structure of CsD <sub>2</sub> AsO <sub>4</sub> with KD <sub>2</sub> PO <sub>4</sub> : see				81Hay
4	Spontaneous shear was observed by neutron diffraction.				76Mey1, 76Mey2
5a	Dielectric constant at low frequencies: Fig. 33A-9-002, Fig. 33A-9-003, Fig. 33A-9-004, Fig. 33A-9-005. Curie-Weiss law: see 5b below. Dielectric dispersion: Fig. 33A-9-006, Fig. 33A-9-007, Fig. 33A-9-008; see also Effect of p on κ <sub>c</sub> : Fig. 33A-9-009. Phase diagram in regard to p: Fig. 33A-9-010, Fig. 33A-9-011. See also Table 33A-7-003 in No. 33A-7. Effect of γ- and electron irradiation on κ <sub>c</sub> and tan δ: see				77Tor  79Pes, 82Pes, 87Kam
b	Nonlinear dielectric properties: E = (ε <sub>0</sub> C) <sup>-1</sup> (T - Θ <sub>p</sub> )P + ξP <sup>3</sup> + ζP <sup>5</sup> , where C = 2.92 · 10 <sup>3</sup> K, ξ = 9.18 · 10 <sup>10</sup> V m <sup>5</sup> C <sup>-3</sup> , ζ = 6.13 · 10 <sup>13</sup> V m <sup>9</sup> C <sup>-5</sup> . Θ <sub>f</sub> = 146.8 K, Θ <sub>f</sub> - Θ <sub>p</sub> = 0.65 K, those parameters are valid for P ≤ 5 · 10 <sup>-2</sup> C m <sup>-2</sup> . See also Table 33A-1-031 in No. 33A-1.				75Cha
c	P <sub>s</sub> vs. T and effect of E <sub>bias</sub> on P <sub>3</sub> : Fig. 33A-9-012.				
6a	Heat capacity: Fig. 33A-9-013, Fig. 33A-9-014.				

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7c	Nonlinear electromechanical parameters: see	82Zai
8a	Elastic stiffness: Table 33A-9-004; Fig. 33A-9-015. $c_{66}^E$ obtained from Brillouin scattering: see Fig. 33A-9-028 in 10a and also Velocity of acoustic wave: Fig. 33A-9-016, Fig. 33A-9-017; see also	74Azo 78Ani
9a	Refractive indices: Table 33A-9-005, Table 33A-9-006, Table 33A-9-007; Fig. 33A-9-018; see also Fig. 33A-1-142 in No. 33A-1. $n_o = 1.567$ , $n_e = 1.546$ for $\lambda = 632.8$ nm; [D: $n_o = 1.567$ at RT for $\lambda = 550$ nm]. Coefficients of Sellmeier equation: see Table 33A-1-040, Table 33A-1-041 in No. 33A-1. $\partial n / \partial T$ : see Table 33A-7-008 in No. 33A-7. Birefringence: Fig. 33A-9-019, Fig. 33A-9-020. Transmission for $\lambda = 300 \dots 2000$ nm: Fig. 33A-9-021. Reflectivity in IR region: Fig. 33A-9-022, Fig. 33A-9-023.	77Ale 69Adh
b	Electrooptic effect: Table 33A-9-008; Fig. 33A-9-024, Fig. 33A-9-025; see also Fig. 33A-7-034, Fig. 33A-7-035 of No. 33A-7. $r_{63}^T = 18.6 \cdot 10^{-12}$ m V <sup>-1</sup> [D: $36.6 \cdot 10^{-12}$ m V <sup>-1</sup> ] at RT for $\lambda = 550$ nm. See also Table 33A-1-048 in No. 33A-1.	69Adh
c	Piezoelectric effect: Fig. 33A-9-026; see also Fig. 33A-7-036 of No. 33A-7. $p_{11} = 0.267$ , $p_{12} = 0.225$ , $p_{13} = 0.200$ , $p_{31} = 0.195$ , $p_{33} = 0.227$ for $\lambda = 632.8$ nm. $p_{66} = 0.025$ .	77Ale 69Vas
d	Gyration tensor: see Fig. 33A-1-197 in No. 33A-1. Electrogyration coefficient: see Fig. 33A-1-202 in No. 33A-1. Verdet constant: see Fig. 33A-8-006 in No. 33A-8.	
e	Nonlinear optical susceptibility: $d_{36}(\text{CDA}) = d_{36}(\text{deuterated CDA}) = 0.40(5) \cdot 10^{-12}$ m V <sup>-1</sup> for $\lambda = 1.064$ $\mu\text{m}$ ; see also	74Kat, 77Nik, 77Sat
10a	Raman scattering: Fig. 33A-9-027. Coupled mode analysis: Fig. 33A-9-028; see also Effect of $p$ : see	71Kat 77Leu
b	Brillouin scattering: Fig. 33A-9-029, Fig. 33A-9-030. $c_{66}^E$ measured by Brillouin scattering: see Fig. 33A-9-028 in 10a and Brillouin and Rayleigh scattering spectra: Fig. 33A-9-031.	74Azo
11	Electrical conductivity from RT to $T_{\text{melt}}$ : see	89Bar
13a	NMR of proton in CsH <sub>2</sub> AsO <sub>4</sub> : Fig. 33A-9-032. NMR of deuteron in CsD <sub>2</sub> AsO <sub>4</sub> : Fig. 33A-9-033, Fig. 33A-9-034; see also Table 33A-1-054 in No. 33A-1. NQR of <sup>75</sup> As: Fig. 33A-9-035; see Fig. 33A-7-050, Fig. 33A-7-051 in No. 33A-7 and also NMR of <sup>133</sup> Cs: Table 33A-9-009; see also	73Bli 72Bli
b	ESR and ENDOR of AsO <sub>4</sub> <sup>4-</sup> : Table 33A-9-010; Fig. 33A-9-036; see also ESR of irradiated crystals: see	86Sam, 91Kah 72Dal

- 14a Domain splitting of neutron diffraction: Fig. 33A-9-037, Fig. 33A-9-038.  
Spontaneous shear and the splitting of the Bragg spot were observed at  $T < \Theta_i$ , giving the shear angle  $\approx 1.75^\circ$ . 76Mey1
- b Neutron diffuse or inelastic scattering: Fig. 33A-9-039, Fig. 33A-9-040.  
A peak corresponding to  $\Sigma_2$  acoustic phonon was observed, see 76Mey1  
See also 74Die
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