

**No. 45A-6 CH<sub>3</sub>NH<sub>3</sub>Al(SO<sub>4</sub>)<sub>2</sub> · 12H<sub>2</sub>O, Methylammonium aluminum sulfate dodecahydrate (MASD)**  
(*M* = 467.36; [*D*]: 497.54])

1a	Ferroelectric activity in CH <sub>3</sub> NH <sub>3</sub> Al(SO <sub>4</sub> ) <sub>2</sub> · 12H <sub>2</sub> O was discovered by Pepinsky et al. in 1956.		56Pep
b	phase	II <sup>a)</sup>	I <sup>a)</sup> <sup>a)</sup> 56Pep
	state	F <sup>a)</sup>	P <sup>a)</sup> <sup>b)</sup> 57Jon
	crystal system	monoclinic <sup>b)</sup>	cubic <sup>b)</sup>
	space group	P2 <sub>1</sub> –C <sub>2</sub> <sup>2</sup> <sup>b)</sup>	P2 <sub>1</sub> 3–T <sup>4</sup> <sup>b)</sup>
	Θ [°C]	–96 <sup>b)</sup>	
	Θ is insensitive to deuteration and remained –96 °C <sup>b)</sup> .		
	Possibility of other space group was proposed: Pa3–T <sub>h</sub> <sup>6</sup> for phase I and Pca2 <sub>1</sub> –C <sub>2v</sub> <sup>5</sup> for phase II.		64Fle
	ρ = 1.585 · 10 <sup>3</sup> kg m <sup>–3</sup> at 23 °C.		57Jon
	Transparent.		
2a	Crystal growth: evaporation or cooling method from aqueous solution.		57Jon
b	Crystal form: Fig. 45A-6-001.		
3a	Unit cell parameter: <i>a</i> = 12.502(1) Å at 23 °C. See also Table 45A-6-002.		57Jon
b	<i>Z</i> = 4 in phase I. Crystal structure: Table 45A-6-001; Fig. 45A-6-002, Fig. 45A-6-003, Fig. 45A-6-004.		57Oka
4	Unit cell parameters: <i>a</i> = 12.462 Å at –82 °C. <i>a</i> = 12.47 <sub>2</sub> Å, <i>b</i> = 12.32 <sub>7</sub> Å, <i>c</i> = 12.28 <sub>2</sub> Å, β = 90° 40' at –165 °C. Lattice distortion: Table 45A-6-002.		57Jon 57Jon
5a	Dielectric constants: Fig. 45A-6-005, Fig. 45A-6-006. Dielectric relaxation: Fig. 45A-6-007, Fig. 45A-6-008; see also Table 45A-4-002 in No. 45A-4. [dΘ/d <i>p</i> ] <sub><i>p</i>=0</sub> = 2.5(1) · 10 <sup>–8</sup> K Pa <sup>–1</sup> ( <i>p</i> ≤ 7 · 10 <sup>8</sup> Pa <sup>–1</sup> , <i>p</i> : hydrostatic pressure).		73Ges
b	Nonlinear dielectric properties: expansion coefficient of the free energy. ξ = –7.2 · 10 <sup>13</sup> V m <sup>5</sup> C <sup>–3</sup> , ζ = 5.4 · 10 <sup>17</sup> V m <sup>9</sup> C <sup>–5</sup> .		57Jon
c	Spontaneous polarization: Fig. 45A-6-009. <i>P</i> <sub>s</sub> = 1.0 · 10 <sup>–2</sup> C m <sup>–2</sup> at about 2 °C below Θ [ <i>D</i> : <i>P</i> <sub>s</sub> = 1.0 · 10 <sup>–2</sup> C m <sup>–2</sup> ]. Coercive field: <i>E</i> <sub>c</sub> = 6 · 10 <sup>5</sup> V m <sup>–1</sup> at about 2 °C below Θ ( <i>f</i> = 60 Hz) [ <i>D</i> : <i>E</i> <sub>c</sub> = 6 · 10 <sup>5</sup> V m <sup>–1</sup> ].		57Jon 57Jon
6a	Heat capacity: Fig. 45A-6-010. Transition entropy, transition heat: Δ <i>Q</i> <sub>m</sub> = 1676 J mol <sup>–1</sup> , Δ <i>S</i> <sub>m</sub> = 9.70 J mol <sup>–1</sup> K <sup>–1</sup> .		68Ash
8a	Sound velocity and elastic stiffness: Fig. 45A-6-011, Fig. 45A-6-012.		

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9a	Birefringence: Fig. 45A-6-013. Refractive index: $n = 1.458(2)$ at RT [D: $n = 1.465(2)$ at RT].	74Zai
b	Electrooptic effect: Fig. 45A-6-014, Fig. 45A-6-015.	
c	Piezooptic constants: $p_{11} = 0.177(11)$ , $p_{12} = 0.288(10)$ , $p_{31} = 0.245(10)$ at 22 °C for $\lambda = 632.8$ nm. Piezooptic effect: Fig. 45A-6-016.	73Mar
d	Optical activity: Fig. 45A-6-017. See Table 45A-4-004 in No. 45A-4.	
13a	NMR: Fig. 45A-6-018, Fig. 45A-6-019; see also	72Vin
b	ESR: Table 45A-6-003. ESR for $\gamma$ -ray irradiated crystal: see	66Koh