

## 46 GASH (C(NH<sub>2</sub>)<sub>3</sub>Al(SO<sub>4</sub>)<sub>2</sub> · 6H<sub>2</sub>O) family

### 46A Pure compounds

#### No. 46A-1 C(NH<sub>2</sub>)<sub>3</sub>Al(SO<sub>4</sub>)<sub>2</sub> · 6H<sub>2</sub>O, Guanidine aluminum sulfate hexahydrate (GASH)

(*M* = 387.27; [D: 405.38])

1a	Ferroelectricity in C(NH <sub>2</sub> ) <sub>3</sub> Al(SO <sub>4</sub> ) <sub>2</sub> · 6H <sub>2</sub> O (GASH) was first reported by Holden et al. in 1955.		55Hol
b	phase	I	
	state	F	
	crystal system	trigonal *)	
	space group	P31m–C <sub>3v</sub> <sup>2 a)</sup>	<sup>a)</sup> 56Woo
	Θ	none **)	
	<i>P</i> <sub>s</sub>    [0001].		55Hol
	ρ <sub>x</sub> = 1.804 · 10 <sup>3</sup> kg m <sup>−3</sup> .		62Gel
	Transparent, colorless.		56Woo
	Cleavage plane: perfect    (0001), less perfect    {11 $\bar{2}$ 0}.		56Woo
	*) In the following description, the hexagonal lattice frame will be used instead of the trigonal one.		
	**) Transition to the paraelectric phase does not exist up to the decomposition temperature of about 200 °C.		
2a	Crystal growth: evaporation of aqueous solution. Solubility in H <sub>2</sub> O: Table 46A-1-001.		55Hol
b	Crystal form: Fig. 46A-1-001.		
3a	Unit cell parameters: <i>a</i> = 11.738(2) Å, <i>c</i> = 8.951(2) Å at RT.		67Sch
b	<i>Z</i> = 3. Crystal structure: Table 46A-1-002, Table 46A-1-003, Table 46A-1-004, Table 46A-1-005; Fig. 46A-1-002.		62Gel
4	Linear thermal expansion coefficients: <i>α</i> <sub>a</sub> = 10.05 · 10 <sup>−6</sup> K <sup>−1</sup> , <i>α</i> <sub>c</sub> = 92.80 · 10 <sup>−6</sup> K <sup>−1</sup> . 0 °C < <i>T</i> < 80 °C.		59Hau2
5a	Dielectric constants: <i>κ</i> <sub>a</sub> = 5, <i>κ</i> <sub>c</sub> = 6 at RT. The dielectric constants are practically temperature independent up to about 100 °C.		56Hol 56Hol
c	Spontaneous polarization and coercive field: Fig. 46A-1-003, Fig. 46A-1-004. Pressure dependence of <i>P</i> <sub>s</sub> : Fig. 46A-1-005. Spontaneous polarization of deuterated crystal: <i>P</i> <sub>s</sub> = 3.5 · 10 <sup>−3</sup> C m <sup>−2</sup> at RT.		55Hol
7a	Piezoelectricity: Fig. 46A-1-006.		
8a	Elastic compliances and stiffnesses: Table 46A-1-006.		

9a	Refractive indices: Table 46A-1-007.	
e	Nonlinear optical susceptibilities: $d_{22}/d_{11}^{\text{quartz}} = -0.31(5)$ , $d_{31}/d_{11}^{\text{quartz}} = +0.025(5)$ , $d_{33}/d_{11}^{\text{quartz}} = 0.059(10)$ , $\lambda = 1.06 \mu\text{m}$ . See also	74Mil 62Sav
10a	Raman scattering: dependence on growth condition: see	88Pol
11	Electrical conductivity: Fig. 46A-1-007; see also	59Gur
13a	NMR: Fig. 46A-1-008. NQR: Table 46A-1-008, Table 46A-1-009.	
b	ESR: Table 46A-1-010; see also	61Bur, 74Zai, 74Man, 75Mil, 77Mil, 77Mis, 80Rei, 84Mis
15a	Domain structure: Fig. 46A-1-009. Domain structure observations using various methods: Powder pattern method: see  Electroluminescence measurement: see Pyroelectric probe method: see Electron and electron scanning microscopes: see  Scanning force microscope: see	59Pea, 78Sud 61Zhe 89Aik 85Szc, 85Beu 93Lut, 94Lut1, 94Lut2, 95Gru, 96Lut
b	Domain switching: Fig. 46A-1-010, Fig. 46A-1-011; see also Bulging-out effect of domain switching: see	95Kol 86Sud
16	Growth defects, spiral growth patterns, etch pits: see	59Nak, 84Hat, 85Hat, 91Rob