No. 26A-2 $BaMnF_4$
(M = 237.63)

1a	It was suggested by Eibschütz et al. in 1969 that $BaMnF_4$ is ferroelectric because the dielectric behavior shows very close resemblance to the ferroelectric $BaMF_4$ (M = Mg, Co, Ni, Zn).	69Eib

	phase	III *)	II *)	I	
b	state	AF^{magn} c)		(F) **)	a) 67Cou
	crystal system			orthorhombic a)	b) 68Sat
	space group			$A2_1am–C_{2v}^{12}$ b)	c) 69Hol
	Θ [K]	25 c)	255 d)		d) 70Spe

	P_s ‖ [100].	69DiD
	T_{melt} = 755(5) °C.	
	$\rho = 4.59(5) \cdot 10^3$ kg m^{-3}, $\rho_X = 4.634 \cdot 10^3$ kg m^{-3}.	69Kev
	Hardness: 3.5 on Mohs' scale.	
	Transparent to visible light up to 10 µm thickness.	68Eib
	*) Incommensurately modulated phase.	79Cox
	**) Polarization reversal has not yet been observed.	
	The average symmetry of phase II is monoclinic, $P2_111–C_2^2$.	83Pis, 86StG, 86Rya, 88Sci
	See subsection 14a.	
	Ferroelectric (pyroelectric) state persists up to the melting point.	
2a	Crystal growth: Bridgman method. Equimolar mixture $BaF_2 + MnF_2$ in a carbon crucible heated in a high vacuum induction furance.	83Sch
	See also	68Eib
3a	Unit cell parameters: a = 5.9845(3) Å, b = 15.098(2) Å, c = 4.2216(3) Å at 298 K.	69Kev
b	Z = 4.	69Kev
	Fractional coordinates of atoms in phase I: Table 26A-2-001.	
	Schematic view of the structure: Fig. 26A-2-001, Fig. 26A-2-002.	
	Temperature parameters and the thermal vibration of atoms at 298 K: Table 26A-2-002, Table 26A-2-003.	
	Interatomic distances and angles: Table 26A-2-004, Table 26A-2-005.	
	Symmetry relation nomenclature for crystal structure data: Table 26A-2-006.	
	See also	85Hid
	Incommensurate modulated structure below $\Theta_{II–I}$: see subsection 14a.	
4	Unit cell parameters a, b, c vs. T: Fig. 26A-2-003.	
	Monoclinic angle below $\Theta_{II–I}$: Fig. 26A-2-004; see also	86Rya, 90Oga
	Volume thermal expansion coefficient: see	90Oga
5a	Dielectric constant: Fig. 26A-2-005, Fig. 26A-2-006 , Fig. 26A-2-007.	
	See also Fig. 26A-1-001 in No. 26A-1.	
	Dielectric constant below 100 K: see	84Kiz
	Dielectric constant at submillimeter range: Fig. 26A-2-008, Fig. 26A-2-009, Fig. 26A-2-010, Fig. 26A-2-011.	

	Effect of hydrostatic pressure on κ_a: Fig. 26A-2-012.	
	Effect of magnetic field on κ_a: Fig. 26A-2-013; see also	85Gri
	Phase diagram (Θ_{II-I} vs. p): Fig. 26A-2-014.	
c	The coercive field is so large that polarization reversal was not found.	
6a	Heat capacity: Fig. 26A-2-015.	
	Critical exponent for the power law: 0.54 ($T \geq 255$ K); >1 ($T \leq 255$ K).	82Sco
	Transition heat: $\Delta Q_m = 31(3)$ J mol^{-1} at ≈255 K,	82Sco
	$\Delta Q_m = 2.4(9)$ J mol^{-1} (small hump) at ≈247 K.	
7, 8	Piezoelectric resonance around Θ_{II-I}: Fig. 26A-2-016.	
	Elastic stiffness constants and piezoelectric stress constants at RT: Table 26A-2-007.	
	Transit time data for modes propagating parallel to the crystal axes: Fig. 26A-2-017, Fig. 26A-2-018, 26A-2-019.	
9a	Crystal is biaxial negative, optic plane (100), $2V = 67.2°$.	68Eib
	$n_a = 1.499(1)$, $n_b = 1.480(1)$, $n_c = 1.505(1)$ at $\lambda = 589.3$ nm.	83Sch
	See also	85Gri
	Temperature dependence of the birefringence: Fig. 26A-2-020;	
	see also	83Sch, 83Pis, 88StG
	Optical absorption spectra: Fig. 26A-2-021.	
	For infrared spectra: see dielectric constant at submillimeter range cited in 5a.	
	Dichroism $(\alpha_c - \alpha_a)/(\alpha_c + \alpha_a)$: Fig. 26A-2-022.	
	Circular dichroism: Fig. 26A-2-023.	
d	Gyration: Fig. 26A-2-024; see also	83Pis, 90Asa
10a	Raman scattering: Table 26A-2-008; Fig. 26A-2-025, Fig. 26A-2-026, Fig. 26A-2-027, Fig. 26A-2-028.	
	See also	81Mur, 82Lyo
	Luminescence life time of the 600 nm emission band vs. T: see	90Tsu
b	Brillouin spectrum, velocity of acoustic phonons: see	78Bec, 81Loc
	Mode coupling phenomena: see	81Lyo
	Phasons, central peak: Fig. 26A-2-029; see also	79Lyo
11	Electrical conductivity along a: $\sigma_a = 1.1 \cdot 10^{-4}\ \Omega^{-1}\ m^{-1}$ at RT.	69Eib
12	Antiferromagnetic at low temperatures: Néel point Θ_N, $\Theta_{III-II} \approx 25$ K.	69Hol
	Magnetic structure at 4.7 K: see	79Cox
	Magnetic susceptibility: Fig. 26A-2-030.	
	Magnetization curves at various T: Fig. 26A-2-031;	
	see also	84Kiz, 90Sci
	Spin flop transition occurs for $\boldsymbol{H} \parallel \boldsymbol{b}$ at $1.15 \cdot 10^6$ A m^{-1} at 20 K, $8.3 \cdot 10^5$ A m^{-1} at 1.4 K.	69Hol
	Also reported at $7.2 \cdot 10^5$ A m^{-1} at 4 K.	90Sci
	Magnetoelectric effect: Fig. 28-2-032; see also	72Als
13b	NMR of ^{19}F: see	75Bar
	Antiferromagnetic resonance at 4.2 K: see	72Pet

14a	Wavevector characterizing the incommensurability: $\boldsymbol{q} = \delta \boldsymbol{a}^* + (\boldsymbol{b}^* + \boldsymbol{c}^*)/2$.	
	Structure of incommensurately modulated phase II: see Satellite reflections: Fig. 26A-2-033, Fig. 26A-2-034, Fig. 26A-2-035. Effect of pressure on the satellite reflection: Fig. 26A-2-036.	88Sci