No. 39A-8 $[N(CH_3)_4]_2CoCl_4$, Tetramethylammonium tetrachlorocobaltate

(M = 349.04; [D: 373.18])

1a Ferroelectricity in $[N(CH_3)_4]_2CoCl_4$ was discovered by Sawada et al. in 1978. 78Saw

b

phase	VII	VI	V	IV **)	III	II *)	I
state	P	P	P		F		P
crystal system	ortho-rhombic	mono-clinic	mono-clinic		ortho-rhombic		ortho-rhombic
space group	$P2_12_12_1$– D_2^{4} [b])	$P12_1/c1$– C_{2h}^{5} [b])	$P112_1/n$– C_{2h}^{5} [b])		$P2_1cn$– C_{2v}^{9} [b])		$Pmcn$– D_{2h}^{16} [a])
Θ [°C]	–151 [D: –153]	–81 –85	4.5 5.1($\Theta_{V–III}$)	6.3	8.0 9.2		20.6 ***) 24.0] [c])

[a]) 67Wie
[b]) 82Has
[c]) 82Ges2

*),**) Incommensurate structural modulation was found along the c axis. 80Has
See subsection 14a.
Super space group in phase II is P(Pmcn):(s1 $\bar{1}$). 85Fja1
**) Phase IV is not found in deuterated crystal. 82Ges1
***) Θ determined by specific heat measurement: see Table 39A-8-005 in 6a.
P_s || [100]. 78Saw
Cleavage plane: (010). 85Saw
$\rho = 1.34(1) \cdot 10^3$ kg m^{-3}. 59Mor

2a Crystal growth: evaporation method from aqueous solution. 78Saw

3a Unit cell parameters: a = 9.001(1) Å, b = 15.539(2) Å, c = 12.276(1) Å at RT. 67Wie

b Z in each phase:

phase	VII	VI	V	IV	III	II	I
Z	12	4	12		20		4

67Wie, 82Has

Crystal structure of phase I: see 67Wie
Average crystal structure of phase III: Table 39A-8-001, Table 39A-8-002, Table 39A-8-003.
Modulation amplitudes in phase III: see 85Fja1

4 Thermal expansion: Fig. 39A-8-001, Fig. 39A-8-002, Fig. 39A-8-003, Fig. 39A-8-004; see also 90Kah

5a Dielectric constant: Fig. 39A-8-005, Fig. 39A-8-006, Fig. 39A-8-007, Fig. 39A-8-008, Fig. 39A-8-009, Fig. 39A-8-010, Fig. 39A-8-011, Fig. 39A-8-012, Fig. 39A-8-013; see also 87Fol
Dielectric dispersion: Fig. 39A-8-014, Fig. 39A-8-015.
Phase diagram in regard to p: Table 39A-8-004; Fig. 39A-8-016, Fig. 39A-8-017, Fig. 39A-8-018.
Phase diagram in regard to uniaxial stress: Fig. 39A-8-019.
Phase diagram in regard to E: Fig. 39A-8-011, Fig. 39A-8-020.

c Spontaneous polarization: Fig. 39A-8-021, Fig. 39A-8-022, Fig. 39A-8-023, Fig. 39A-8-024, Fig. 39A-8-025.

6a Heat capacity: Fig. 39A-8-026, Fig. 39A-8-027.
Transition heat, transition entropy: Table 39A-8-005.

8a	Sound velocity and absorption coefficient: Fig. 39A-8-028, Fig. 39A-8-029, Fig. 39A-8-030, Fig. 39A-8-031.	
9a	Optical absorption in the ultraviolet region: Fig. 39A-8-032. Infrared absorption: see	 85Gan
10a	Raman scattering: see	80Tak
13b	ESR of Mn^{2+} doped crystal: Table 39A-8-006; Fig. 39A-8-033. See also	 83Fuk
14a	Bragg reflections due to structural modulations: Fig. 39A-8-034, Fig. 39A-8-035; see also Effect of X-ray radiation on the structural modulation: see	 81Mar, 85Fja2, 89Fol 85Fja2