58B Solid solutions

No. 58B-1 $Ca_2Sr(CH_3CH_2COO)_6$–$Ca_2Ba(CH_3CH_2COO)_6$ (DSP–DBP)

5a	Dielectric constant: Fig. 58B-1-001.
c	Spontaneous polarization: Fig. 58B-1-002.

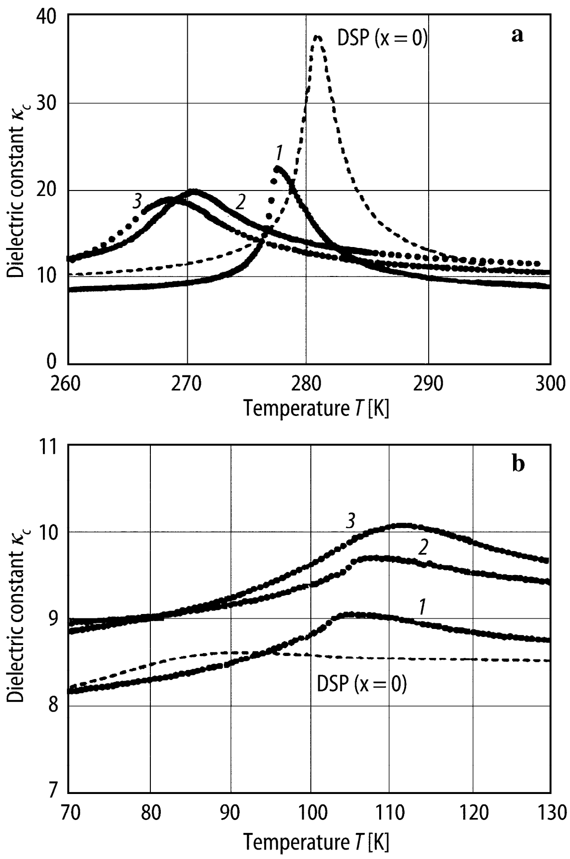

Fig. 58B-1-001. $Ca_2Sr_{1-x}Ba_x(CH_3CH_2COO)_6$ (DSP–DBP). κ_c vs. T [94Suz]. Parameter: x. f = 100 kHz. (**a**) Near Θ_{II-I}. (**b**) Near Θ_{III-II}. *1*, *2*: 0 < x ≤ 0.05. *3*: x = 0.13(5). Dashed line: x = 0 (DSP).

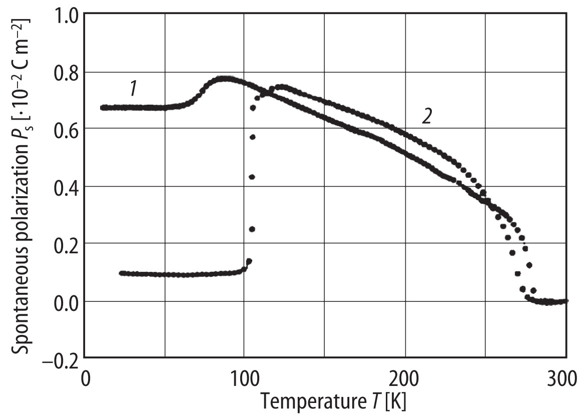

Fig. 58B-1-002. $Ca_2Sr_{1-x}Ba_x(CH_3CH_2COO)_6$ (DSP–DBP). P_s vs. T [94Suz]. *1*: x = 0 (DSP). *2*: 0 < x ≤ 0.05, the same specimen as that of *2* in Fig. 58B-1-001.

Reference

94Suz Suzuki, H., Takashige, M., Sawada, S.: Ferroelectrics **158** (1994) 175.

No. 58B-2 $Ca_2Sr(CH_3CH_2COO)_6$–$Ca_2Pb(CH_3CH_2COO)_6$ (DSP–DLP)

1b	Phase diagram: Fig. 58B-2-001.
2a	Molar fractions of DLP in the aqueous solution and in the crystal: Fig. 58B-2-002.
4	Thermal expansion: see Fig. 58A-3-008 in No. 58A-3.

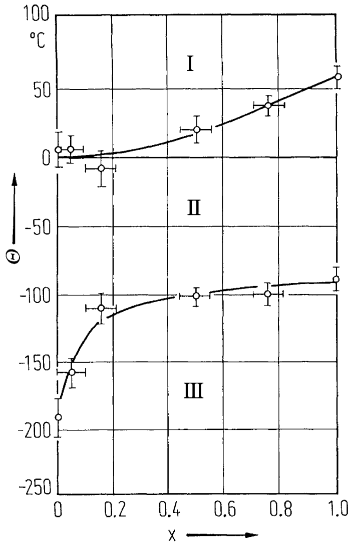

Fig. 58B-2-001. $Ca_2Sr_{1-x}Pb_x(CH_3CH_2COO)_6$ (DSP–DLP). Phase diagram [76Nag].

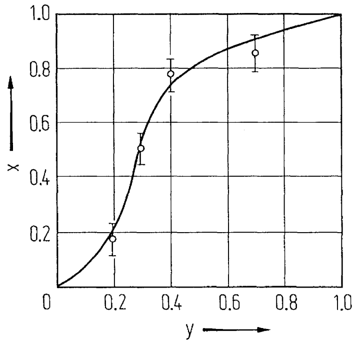

Fig. 58B-2-002. $Ca_2Sr_{1-x}Pb_x(CH_3CH_2COO)_6$ (DSP–DLP). x vs. y [76Nag]. y: molar fraction of $Ca_2Sr_{1-x}Pb_x(CH_3CH_2COO)_6$ in aqueous solution. T = 40 °C.

Reference

76Nag Nagae, Y., Ishibashi, Y., Takagi, Y., Kameyama, H.: J. Phys. Soc. Jpn. **41** (1976) 1300.

No. 58B-3 $Ca_2Ba(CH_3CH_2COO)_6$–$Ca_2Pb(CH_3CH_2COO)_6$ (DBP–DLP)

1a	Pyroelectric properties of DLP based DBP–DLP solid solution was investigated by Chobot and Varikash in 1988.	88Cho
5c	Spontaneous polarization: Fig. 58B-3-001.	

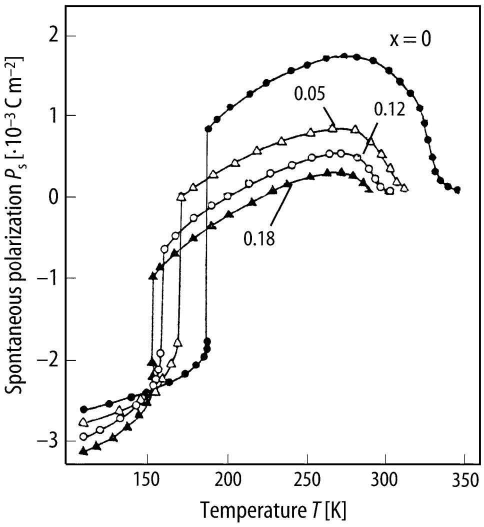

Fig. 58B-3-001. $Ca_2Pb_{1-x}Ba_x(CH_3CH_2COO)_6$ (DBP–DLP). P_s vs. T [88Cho]. Parameter: x. P_s was determined from pyroelectric current.

Reference

88Cho Chobot, G.M., Varikash, V.M.: Dokl. Akad. Nauk BSSR **32** (1988) 223.

No. 58B-4 $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(CH_3COO)_{6x}$ (DSPA)

1a	Ferroelectricity of $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(CH_3COO)_{6x}$ mixed crystals was first investigated by Nakamura et al. in 1969.	69Nak
b	Phase transition temperature: Fig. 58B-4-001, Fig. 58B-4-002, Fig. 58B-4-003, Fig. 58B-4-004.	
4	Thermal expansion: Fig. 58B-4-005.	
5a	Dielectric constant: Fig. 58B-4-006, Fig. 58B-4-007, Fig. 58B-4-008, Fig. 58B-4-009, Fig. 58B-4-010, Fig. 58B-4-011.	
c	Spontaneous polarization: Fig. 58B-4-012.	

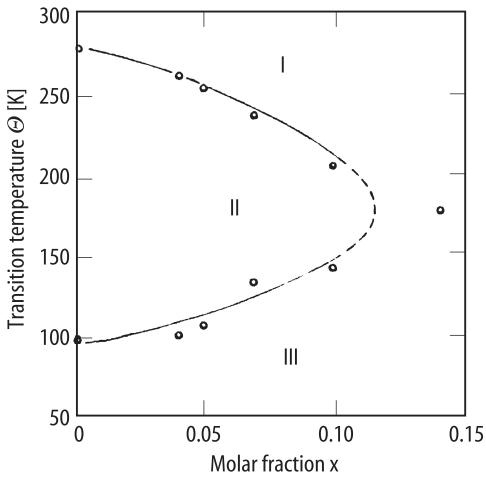

Fig. 58B-4-001. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(CH_3COO)_{6x}$ (DSPA). Θ vs. x [92Suz].

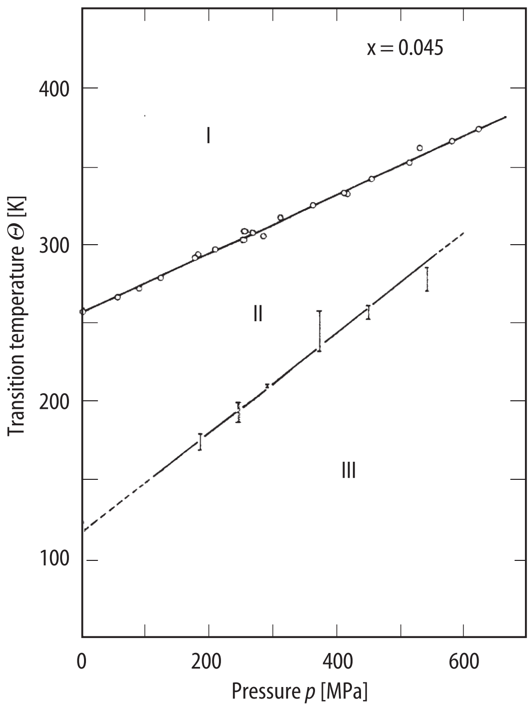

Fig. 58B-4-002. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(CH_3COO)_{6x}$ (DSPA). Θ vs. p [92Ges]. x = 0.045.

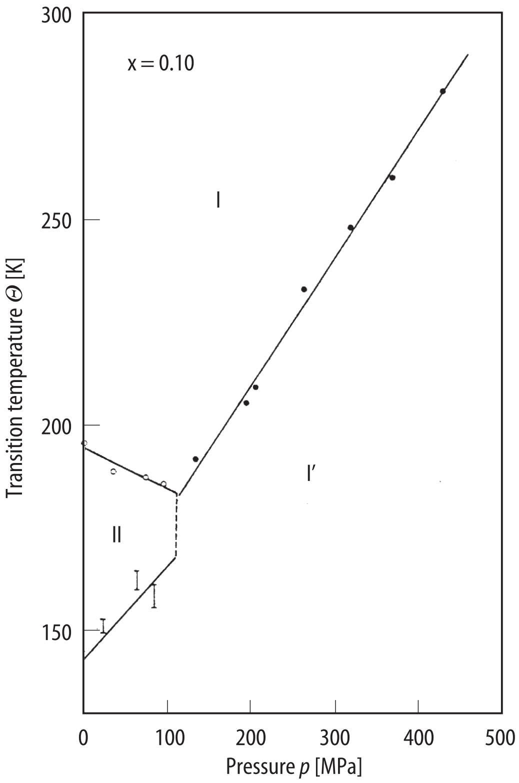

Fig. 58B-4-003. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(CH_3COO)_{6x}$ (DSPA). Θ vs. p [92Ges]. x = 0.10. Open circle: II–I transition. Full circle: broad maximum of dielectric constant.

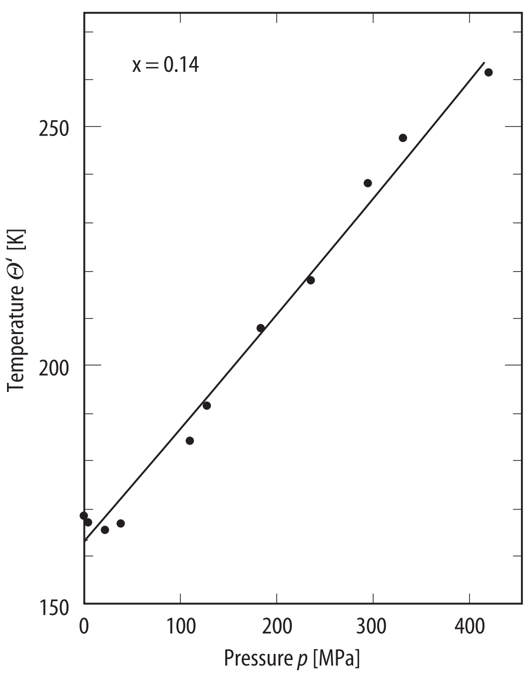

Fig. 58B-4-004. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(CH_3COO)_{6x}$ (DSPA). Θ' vs. p [92Ges]. x = 0.14. Θ': temperature at which dielectric constant shows maximum.

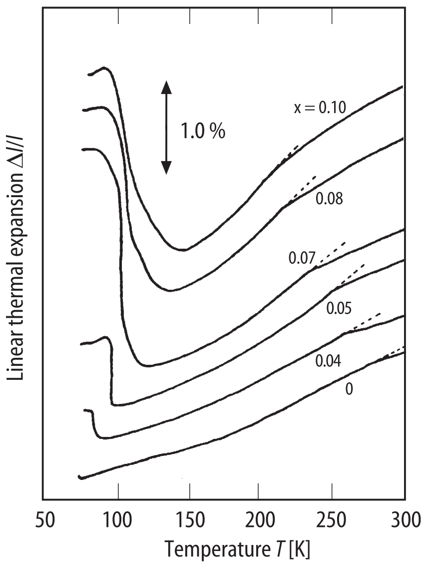

Fig. 58B-4-005. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(CH_3COO)_{6x}$ (DSPA). $\Delta l/l$ vs. T [92Suz]. Parameter: x. $\Delta l/l$: linear thermal expansion along the *c* axis.

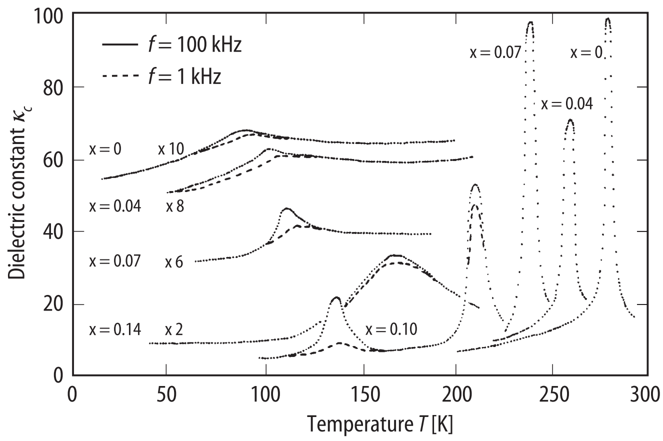

Fig. 58B-4-006. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(CH_3COO)_{6x}$ (DSPA). κ_c vs. T [90Tak1]. Parameter: x.

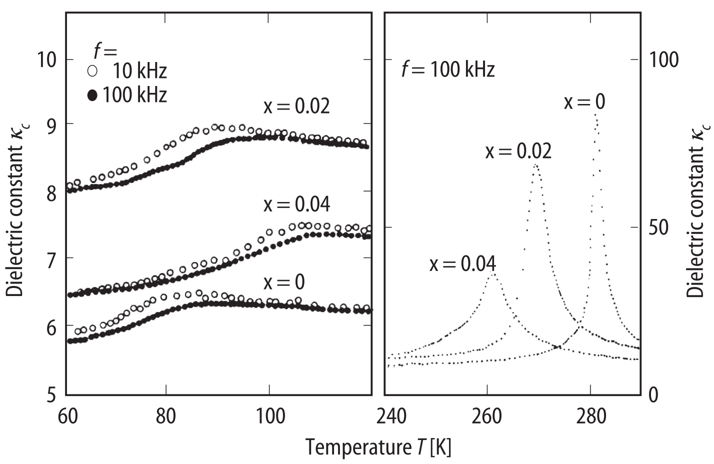

Fig. 58B-4-007. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(CH_3COO)_{6x}$ (DSPA). κ_c vs. T [90Tak2]. Parameter: x. On cooling.

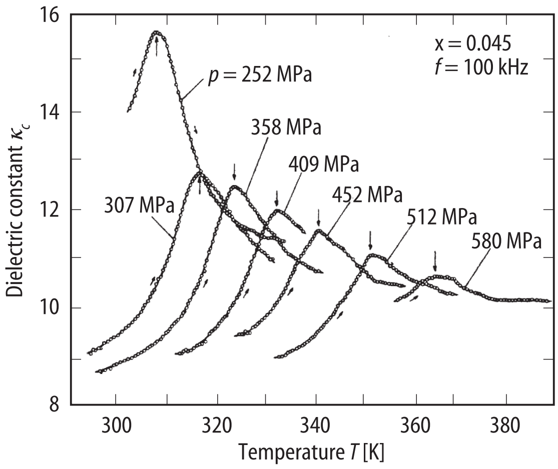

Fig. 58B-4-008. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(CH_3COO)_{6x}$ (DSPA). κ_c vs. T [92Ges]. Parameter: p. x = 0.045.

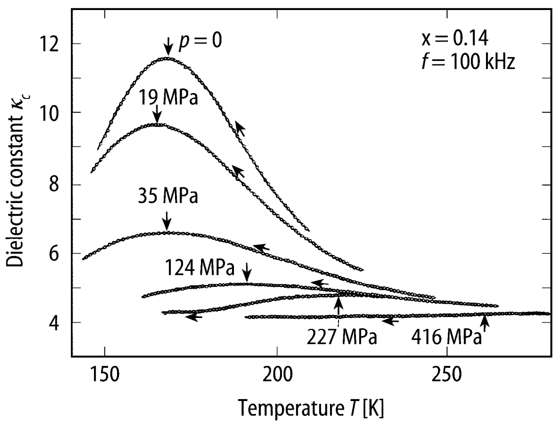

Fig. 58B-4-009. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(CH_3COO)_{6x}$ (DSPA). κ_c vs. T [92Ges]. Parameter: p. x = 0.14.

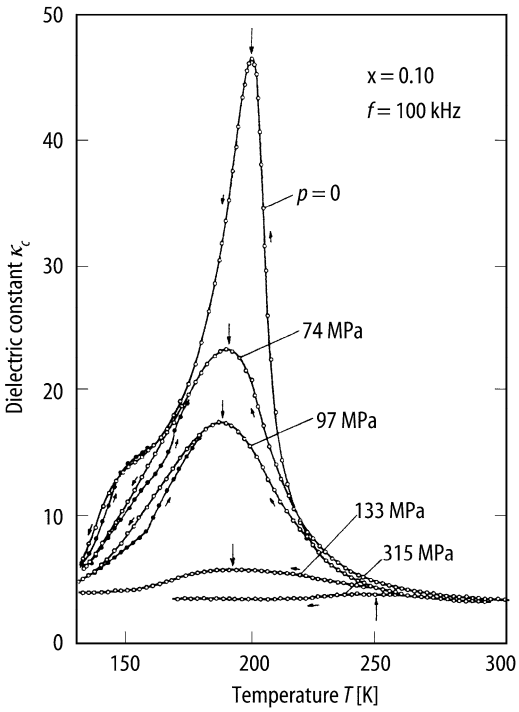

Fig. 58B-4-010. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(CH_3COO)_{6x}$ (DSPA). κ_c vs. T [92Ges]. Parameter: p. x = 0.10.

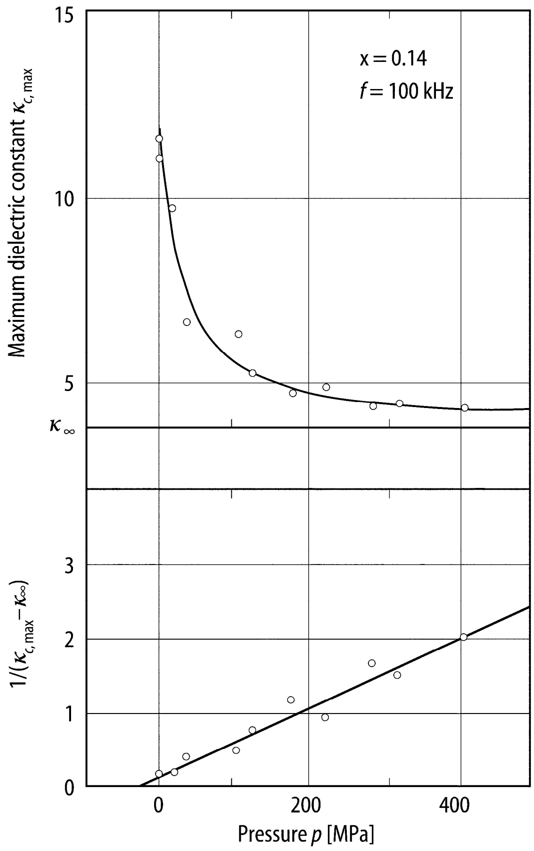

Fig. 58B-4-011. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(CH_3COO)_{6x}$ (DSPA). $\kappa_{c,\,max}$, $1/(\kappa_{c,\,max} - \kappa_\infty)$ vs. p [92Ges]. $\kappa_{c,\,max}$: maximum dielectric constant at broad peak. x = 0.14. $\kappa_\infty = 3.74$.

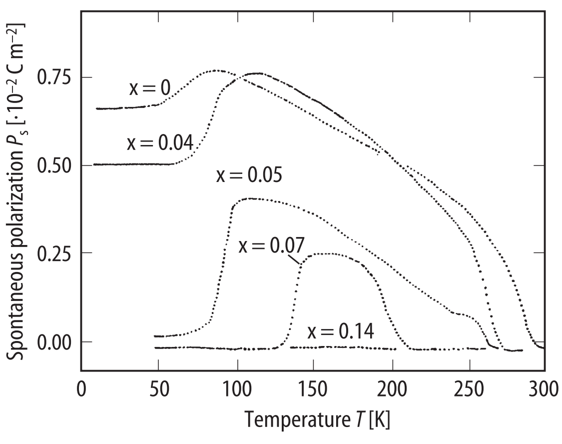

Fig. 58B-4-012. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(CH_3COO)_{6x}$ (DSPA). P_s vs. T [92Suz]. Parameter: x.

References

69Nak Nakamura, E., Nagai, T., Hashimoto, S., Hosoya, M.: J. Phys. Soc. Jpn. **26** (1969) 979.
90Tak1 Takashige, M., Shimizu, F., Suzuki, H., Sawada, S.: J. Phys. Soc. Jpn. **59** (1990) 3475.
90Tak2 Takashige, M., Shimizu, F., Suzuki, H., Sawada, S.: J. Phys. Soc. Jpn. **59** (1990) 2291.
92Ges Gesi, K., Takashige, M.: J. Phys. Soc. Jpn. **61** (1992) 2134.
92Suz Suzuki, H., Shimizu, F., Takashige, M. Sawada, S.: Ferroelectrics **125** (1992) 33.

No. 58B-5 $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(HCF_2COO)_{6x}$

1a	Dielectric properties were investigated by Yano et al. in 1989.	89Yan
b	Phase diagram: Fig. 58B-5-001.	
5a	Dielectric constant: Fig. 58B-5-002, Fig. 58B-5-003.	
13a	Proton spin-lattice relaxation time: Fig. 58B-5-004, Fig. 58B-5-005. Activation energy of CH_3 reorientation: Table 58B-5-001.	

Table 58B-5-001. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(HCF_2COO)_{6x}$. ΔU, τ_0 vs. x [93Sat]. ΔU: activation energy of CH_3 reorientation obtained from ^1H spin-lattice relaxation time. τ_0: correlation time τ_c at infinite temperature, $\tau_c = \tau_0 \exp(\Delta U/RT)$.

	CH_3 groups of two propionate anions		CH_3 groups of four propionate anions	
	ΔU [kJ mol^{-1}]	τ_0 [s]	ΔU [kJ mol^{-1}]	τ_0 [s]
x = 0 (DSP)	9.8	$1.8 \cdot 10^{-13}$	8.7	$1.8 \cdot 10^{-13}$
6x = 0.02	10.0	$1.5 \cdot 10^{-13}$	9.0	$1.5 \cdot 10^{-13}$
6x = 0.24	9.7	$2.3 \cdot 10^{-13}$	8.4	$2.3 \cdot 10^{-13}$
6x = 0.65	9.5	$5.4 \cdot 10^{-13}$	8.0	$5.4 \cdot 10^{-13}$

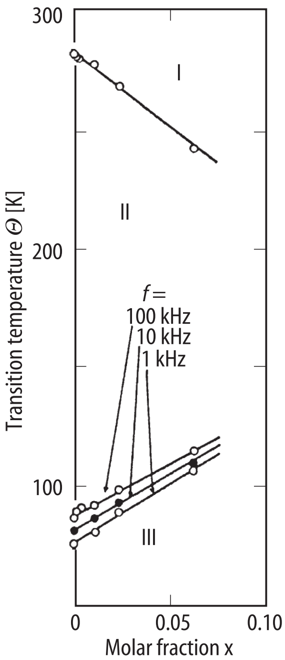

Fig. 58B-5-001. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(HCF_2COO)_{6x}$. Θ vs. x [89Yan]. Parameter: *f*.

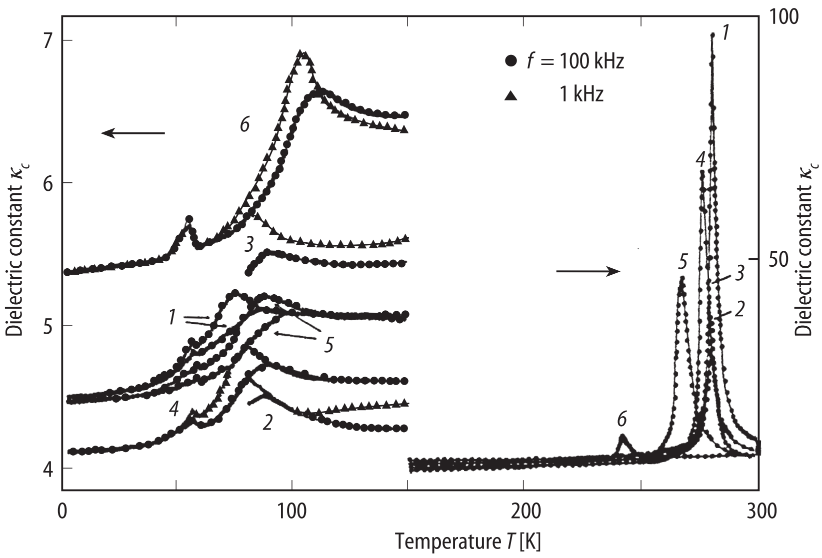

Fig. 58B-5-002. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(HCF_2COO)_{6x}$. κ_c vs. T [89Yan]. Parameter: x, *f*. *1*: x = 0. *2*: $1.35 \cdot 10^{-3}$. *3*: $2.67 \cdot 10^{-3}$. *4*: $1.08 \cdot 10^{-2}$. *5*: $2.33 \cdot 10^{-2}$. *6*: $6.17 \cdot 10^{-2}$.

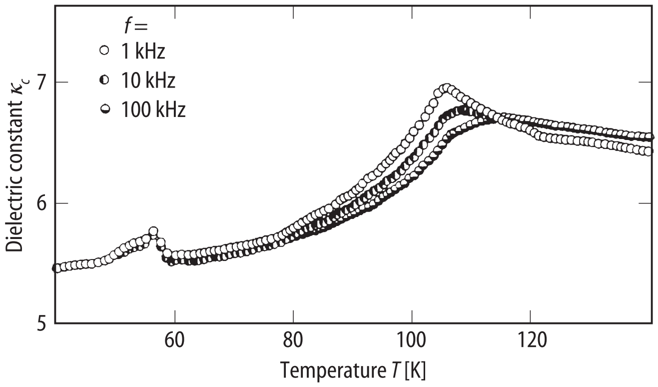

Fig. 58B-5-003. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(HCF_2COO)_{6x}$ ($x = 6.17 \cdot 10^{-2}$). κ_c vs. T [89Yan]. Parameter: f.

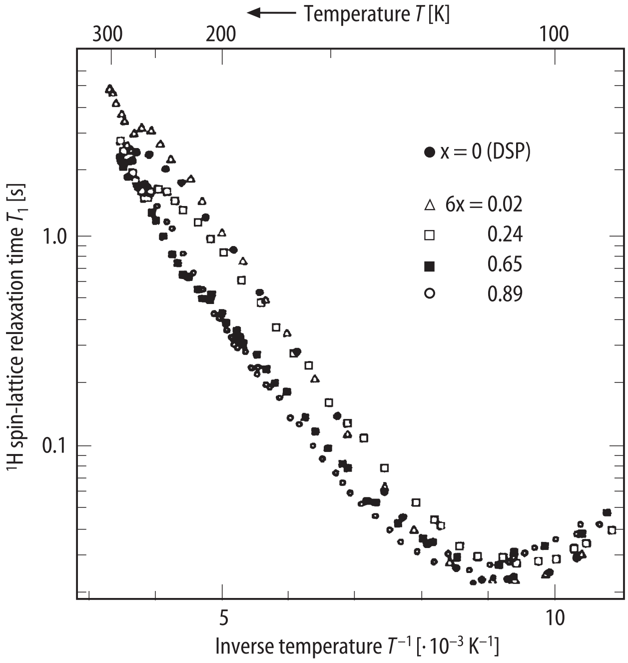

Fig. 58B-5-004. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(HCF_2COO)_{6x}$. T_1 vs. T^{-1} [93Sat]. T_1: ^{1}H spin-lattice relaxation time.

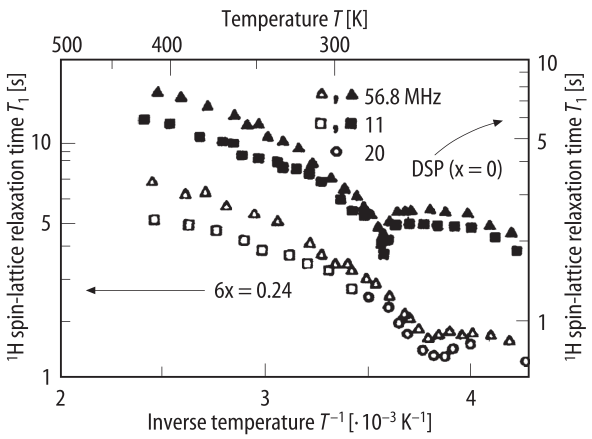

Fig. 58B-5-005. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(HCF_2COO)_{6x}$. T_1 vs. T^{-1} near Θ_{II-I} [93Sat]. T_1: ^{1}H spin-lattice relaxation time.

References

89Yan Yano, S., Sahara, M., Iwauchi, K.: J. Phys. Soc. Jpn. **58** (1989) 577.
93Sat Sato, S., Yano, S., Ikeda, R., Nakamura, D.: J. Phys. Soc. Jpn. **62** (1993) 793.

No. 58B-6 $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(HCF_2CF_2COO)_{6x}$

1a	Dielectric properties were investigated by Yano et al. in 1987.	87Yan
b	Phase diagram: Fig. 58B-6-001; see also Fig. 58B-6-005 in subsection 5a.	
5a	Dielectric constant: Fig. 58B-6-002, Fig. 58B-6-003, Fig. 58B-6-004. Θ vs. x determined by dielectric constant measurement: Fig. 58B-6-005.	
c	Spontaneous polarization: Fig. 58B-6-006.	

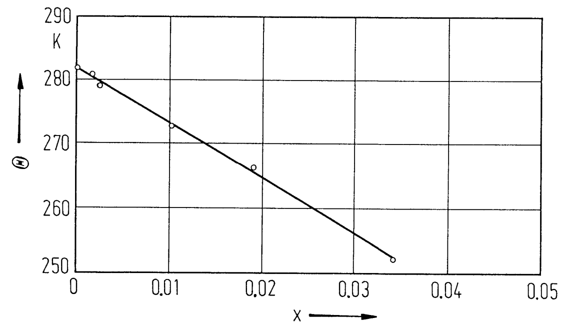

Fig. 58B-6-001. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(HCF_2CF_2COO)_{6x}$. Θ vs. x [87Yan].

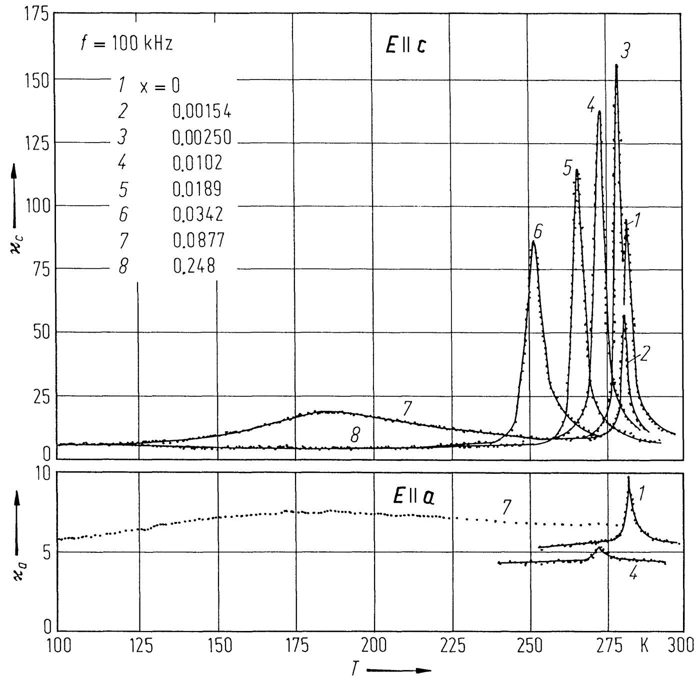

Fig. 58B-6-002. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(HCF_2CF_2COO)_{6x}$. κ_c, κ_a vs. T [87Yan]. Parameter: x.

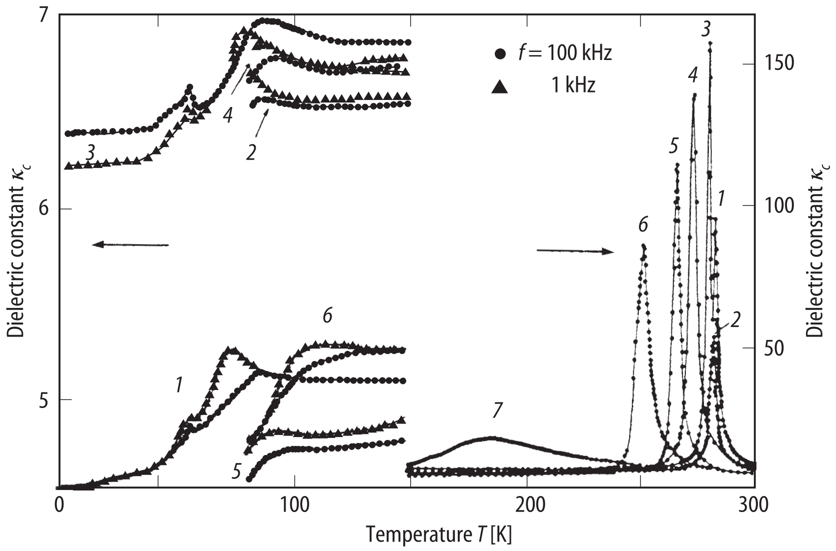

Fig. 58B-6-003. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(HCF_2CF_2COO)_{6x}$. κ_c vs. T [89Yan]. Parameter: x, *f*. *1*: x = 0. *2*: $1.54 \cdot 10^{-3}$. *3*: $2.50 \cdot 10^{-3}$. *4*: $1.02 \cdot 10^{-2}$. *5*: $1.89 \cdot 10^{-2}$. *6*: $3.42 \cdot 10^{-2}$. *7*: $8.77 \cdot 10^{-2}$.

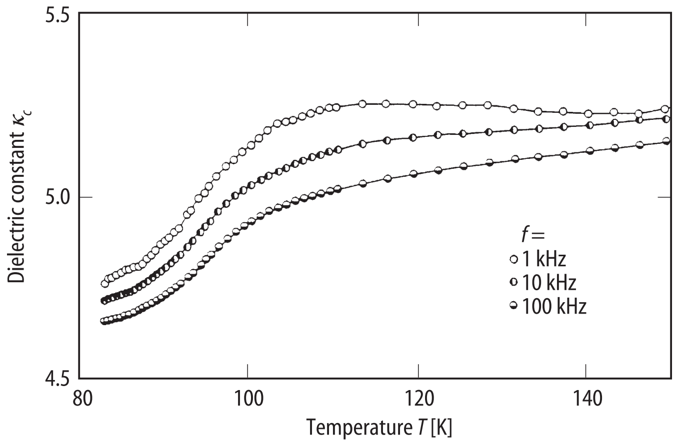

Fig. 58B-6-004. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(HCF_2CF_2COO)_{6x}$ ($x = 3.42 \cdot 10^{-2}$). κ_c vs. T [89Yan]. Parameter: *f*.

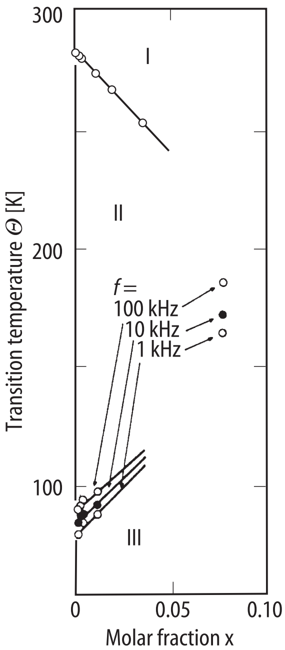

Fig. 58B-6-005. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(HCF_2CF_2COO)_{6x}$. Θ vs. x [89Yan]. Parameter: *f*.

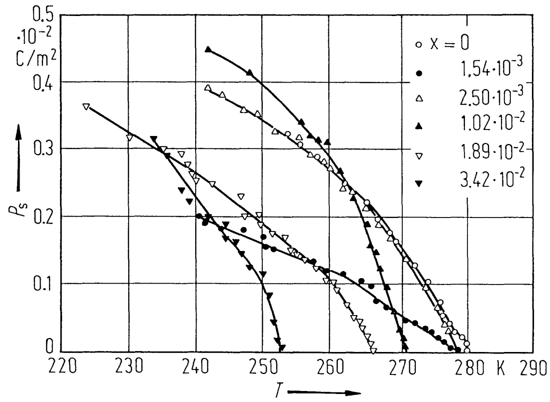

Fig. 58B-6-006. $Ca_2Sr(CH_3CH_2COO)_{6(1-x)}(HCF_2CF_2COO)_{6x}$. P_s vs. T [87Yan]. Parameter: x.

References

87Yan Yano, S., Yamada, K., Shimizu, H.: J. Phys. Soc. Jpn. **56** (1987) 3338.
89Yan Yano, S., Sahara, M., Iwauchi, K.: J. Phys. Soc. Jpn. **58** (1989) 577.

No. 58B-7 $Ca_2Pb(CH_3CH_2COO)_{6(1-x)}(CH_3COO)_{6x}$ (DLPA)

1a	Dielectric properties were investigated by Takashige et al. in 1990.	90Tak
b	Phase diagram: Fig. 58B-7-001.	
5a	Dielectric constant: Fig. 58B-7-002, Fig. 58B-7-003.	
c	Spontaneous polarization: Fig. 58B-7-004.	

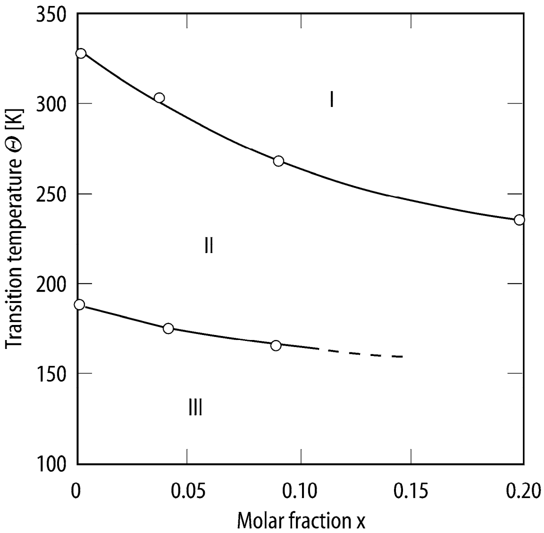

Fig. 58B-7-001. $Ca_2Pb(CH_3CH_2COO)_{6(1-x)}(CH_3COO)_{6x}$ (DLPA). Θ vs. x [92Suz].

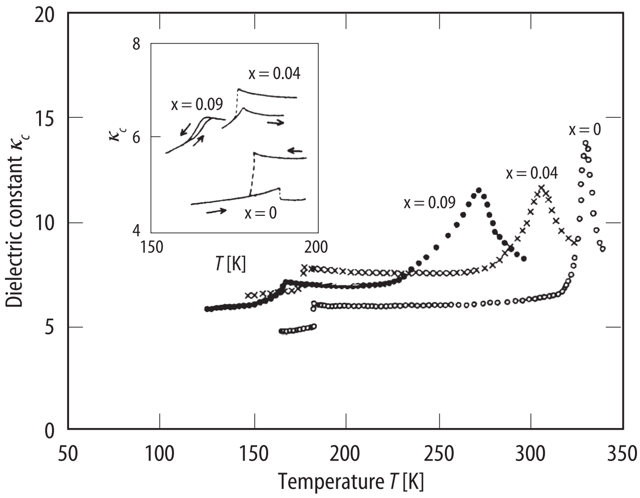

Fig. 58B-7-002. $Ca_2Pb(CH_3CH_2COO)_{6(1-x)}(CH_3COO)_{6x}$ (DLPA). κ_c vs. T [92Tak]. Parameter: x.

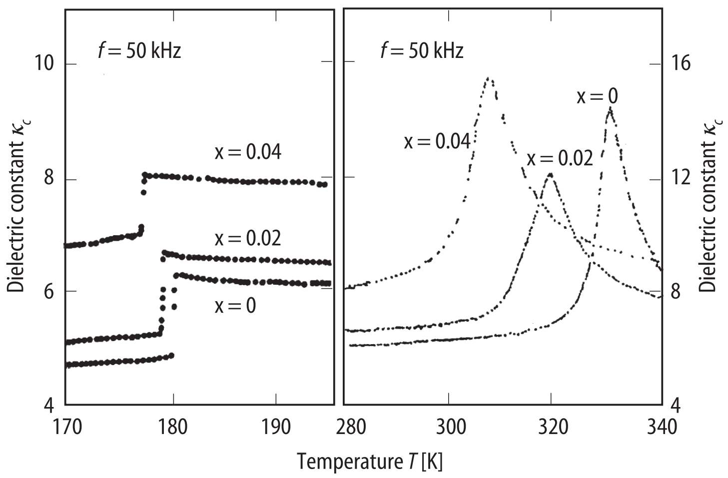

Fig. 58B-7-003. $Ca_2Pb(CH_3CH_2COO)_{6(1-x)}(CH_3COO)_{6x}$ (DLPA). κ_c vs. T [90Tak]. Parameter: x.

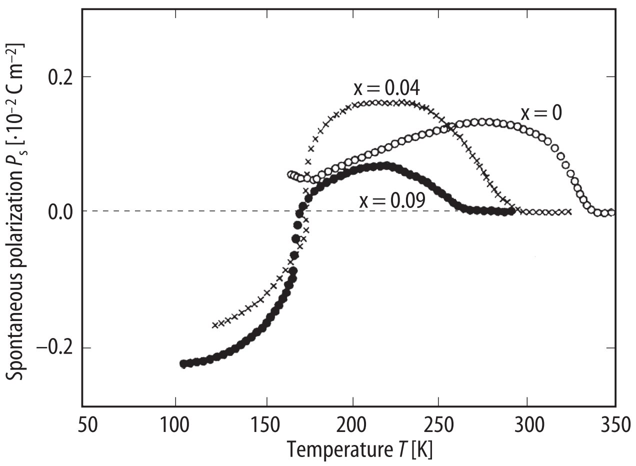

Fig. 58B-7-004. $Ca_2Pb(CH_3CH_2COO)_{6(1-x)}(CH_3COO)_{6x}$ (DLPA). P_s vs. T [92Tak]. Parameter: x.

References

90Tak Takashige, M., Shimizu, F., Suzuki, H., Sawada, S.: J. Phys. Soc. Jpn. **59** (1990) 2291.
92Suz Suzuki, H., Shimizu, F., Takashige, M., Sawada, S.: Ferroelectrics **125** (1992) 33.
92Tak Takashige, M., Shimizu, F., Suzuki, H., Sawada, S.: J. Phys. Soc. Jpn. **61** (1992) 397.