No. 1B-d4 $Pb(Mg_{1/3}Nb_{2/3})O_3$
(M = 325.2)

1a Ferroelectricity in $Pb(Mg_{1/2}Nb_{2/3})O_3$ with perovskite structure was discovered by Smolenskii and Agranovskaya in 1958. — 58Smo, 59Smo

b

phase	II	I
state	F	P
crystal system	pseudocubic	cubic
space group		$Pm3m - O_h^1$
Θ [K]	265 (average)	

References: 60Ism, 60Smo, 65Ouc

This transition is a diffuse phase transition smeared around 265 K.
$\rho = 8.12\cdot10^3$ kg m^{-3}.
Color: transparent, pale yellow. — 67Bon1

2a Crystal growth: flux growth with PbO [a]), Kyropoulos method [b]). — [a])59Myl, [b])67Bon1

To sinter pyrochlore-free PMM, magnesium and niobium oxides were first prereacted to form the columbite $MgNb_2O_6$ and then followed by a reaction with lead oxide: see — 82Swa

3a Unit cell parameters: a = 4.041 Å at RT. — 60Ism

a = 4.020 Å, c = 4.044 Å at T = – 15 °C.

b Electron diffraction and high resolution electron microscopy studies evidenced nanodomains or clusters in which the Mg^{2+} and Nb^{5+} cations are 1-1 ordered in the B site of the perovskite. These domains are of ideal formula $PbMg_{1/2}Nb_{1/2}O_3$ and center faced cubic structure with of around 2...5 nm. — 89Che, 90Ran

4 Thermal expansion: Fig. 1B-d4-001.

5a Dielectric constant: Figs. 1B-d4-002...1B-d4-015.
Effect of 1% La doping on κ: Fig. 1B-d4-016,
see also — 94Eli
Effect of excess PbO and MgO on κ and tan δ: see — 88Kan, 84Swa
Effect of V_2O_5 doping on κ: see — 93EoK
Effect of Li_2CO_3 and LiF on κ and tan δ: see — 85Ros
κ and tan δ of PbO–MgO–Nb_2O_5 near the $Pb(Mg_{1/3}Nb_{2/3})O_3$ ceramic composition: see — 89Yan1, 89Yan2
Models on the dielectric behavior in the PMN were proposed: see — 91Vie, 92Wes

b Nonlinear dielectric properties: $E = [(T-\Theta_p)(\kappa_0 C)^{-1}]P+\xi P^3+\zeta P^5+ ...$, where Θ_p = 265 K, $C = 3.7(10)\cdot10^5$ K, and $\xi \approx 5.6\cdot10^8$ V m^{5}C^{-3}. — 67Bon2

c Spontaneous polarization: Fig. 1B-d4-017, Fig. 1B-d4-018.
$P_r = 11\cdot10^{-2}$ Cm^{-2} at RT; film thickness: 0.44 µm. — 92Uda
Electrocaloric effect: Fig. 1B-d4-019.

6a Specific heat capacity: Fig. 1B-d4-020.

b Thermal conductivity: Fig. 1B-d4-021.

7a Piezoelectricity: Fig. 1B-d4-022.

b Electrostriction: Fig. 1B-d4-023.

8a	Elastic stiffness: Fig. 1B-d4-024. Effect of pressure on elastic stiffness: Fig. 1B-d4-025; Table 1B-d4-001.	
9a	Refractive index: Table 1B-d4-002, Figs. 1B-d4-026...1B-d4-028. Birefringence: Fig. 1B-d4-029, Fig. 1B-d4-030. Infrared spectrum: Fig. 1B-d4-031, Fig. 1B-d4-032.	
b	Electrooptic effect: Figs. 1B-d4-033...1B-d4-037.	
c	Nonlinear optical property: Fig. 1B-d4-038, see also Fig. 1B-c9-015.	
10a	Raman scattering: Fig. 1B-d4-039. Brillouin scattering: Fig. 1B-d4-040, see also Rayleigh scattering: The integrated scattering of light is observed to decrease with rising temperature from 20 to 400 °C, and to vanish practically at 360 °C.	 77Smo 74Smo
11a	Electrical conductivity: Fig. 1B-d4-041. Drift mobility: $\mu \approx 0.5 \cdot 10^{-4}$ m^{2}V^{-1}s^{-1} for electrons, $\mu \approx 0.35 \cdot 10^{-4}$ m^{2}V^{-1}s^{-1} for holes at 20 °C. Photoconductivity: see	 77Tre 76Tre
14	Electron diffraction and high resolution transmission electron microscopy: see High resolution electron microscopy on epitaxial thin film: see	94Par, 95Bur 91Oku
16	Application to spatial light modulation: see Domain structure in the field-induced polar phase was observed by polarized light. Particle and grain size effect on the dielectric behavior: see	84Ber 81Set, 93YeZ 90Pap

Table 1B-d4-001. $Pb(Mg_{1/3}Nb_{2/3})O_3$ (ceramics). Isothermal pressure derivative of elastic stiffnesses $(\partial c_L/\partial p)_T$, $(\partial c_s/\partial p)_T$ [87Mah]. f = 10 MHz. c_L: longitudinal elastic modulus. c_s: shear elastic modulus. Parameter: T.

T [K]	$(\partial c_L/\partial p)_T$ [$\cdot 10^8$ Nm^{-2}K^{-1}]	$(\partial c_s/\partial p)_T$ [$\cdot 10^8$ Nm^{-2}K^{-1}]
195	21(1)	7.9(3)
274	20.7	7.9
295	20.8	7.7

Table 1B-d4-002. $Pb(Mg_{1/3}Nb_{2/3})O_3$. n vs. λ at RT [83Kor].

λ [nm]	n	λ [nm]	n
404.7	2.7720	576.9	2.5491
435.8	2.6982	579.0	2.5479
441.6	2.6878	632.8	2.5219
546.1	2.5688	1152.3	2.4371

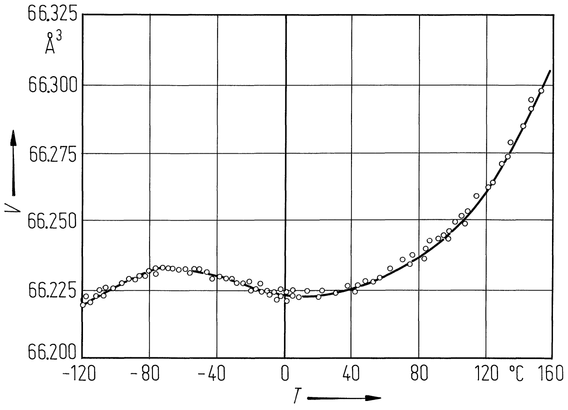

Fig. 1B-d4-001. $Pb(Mg_{1/3}Nb_{2/3})O_3$ (ceramics). *V* vs. *T* [80Zvi]. *V*: volume of unit cell.

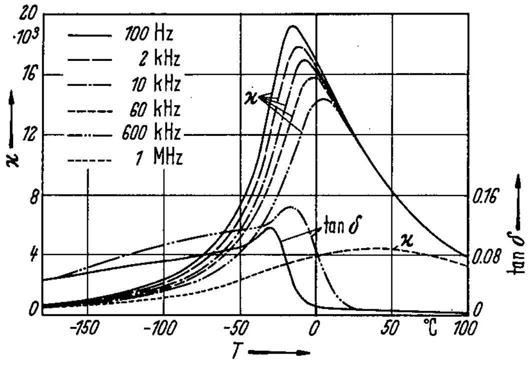

Fig. 1B-d4-002. $Pb(Mg_{1/3}Nb_{2/3})O_3$ (ceramics). κ, $\tan\delta$ vs. T [60Smo]. Parameter: f.

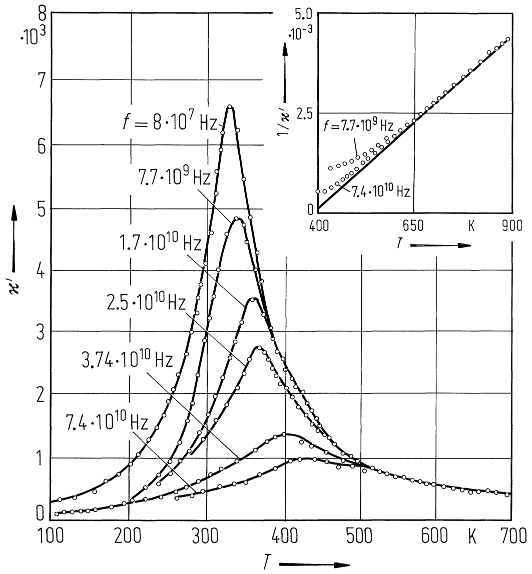

Fig. 1B-d4-003. $Pb(Mg_{1/3}Nb_{2/3})O_3$. *κ*' vs. *T* [85Pop]. Parameter: *f*.

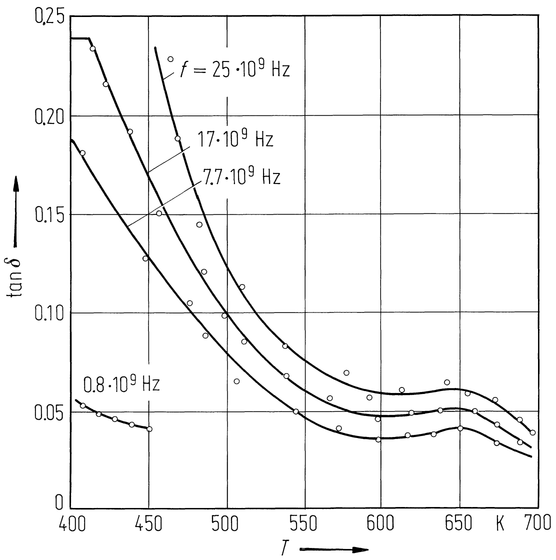

Fig. 1B-d4-004. $Pb(Mg_{1/3}Nb_{2/3})O_3$. $\tan\delta$ vs. T [85Pop]. Parameter: f.

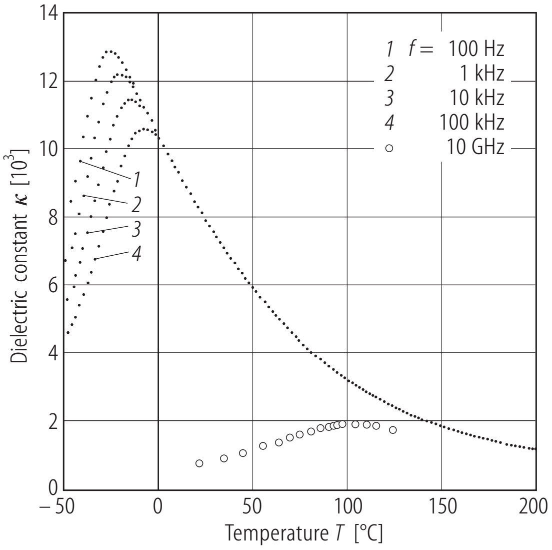

Fig. 1B-d4-005. $Pb(Mg_{1/3}Nb_{2/3})O_3$ (ceramics). κ vs. T [89Lan]. Parameter: *f*.

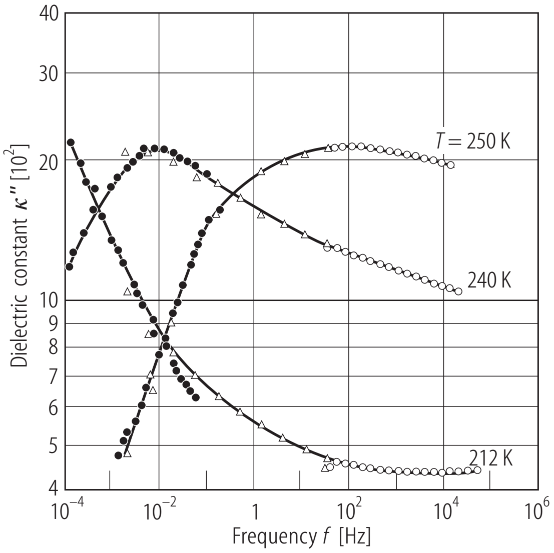

Fig. 1B-d4-006. $Pb(Mg_{1/3}Nb_{2/3})O_3$. *κ*'' vs. *f* [94Chr]. Parameter: *T*. Full circles: measured with depolarization current method. Open circles: bridge method. Open triangles: the data by Colla et al. [92Col].

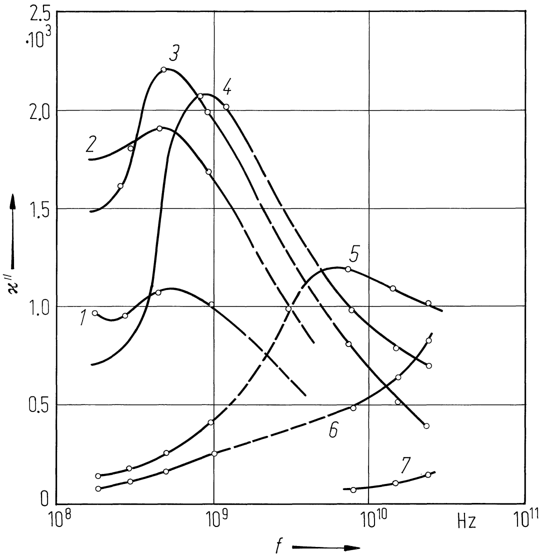

Fig. 1B-d4-007. $Pb(Mg_{1/3}Nb_{2/3})O_3$. κ'' vs. *f* [85Pop]. Parameter: *T*. Curve *1*: 270 K, *2*: 290 K, *3*: 300 K, *4*: 320 K, *5*: 360 K, *6*: 400 K, *7*: 500 K.

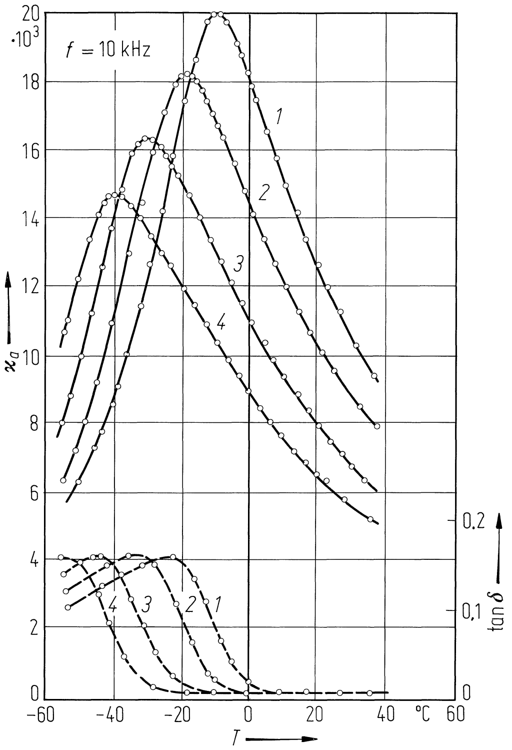

Fig. 1B-d4-008. $Pb(Mg_{1/3}Nb_{2/3})O_3$. κ_a, $\tan\delta$ vs. *T* [79Fri]. *f* = 10 kHz. Parameter: *p*. Curve *1*: 0 GPa, *2*: 0.290 GPa, *3*: 0.615 GPa, *4*: 0.906 GPa.

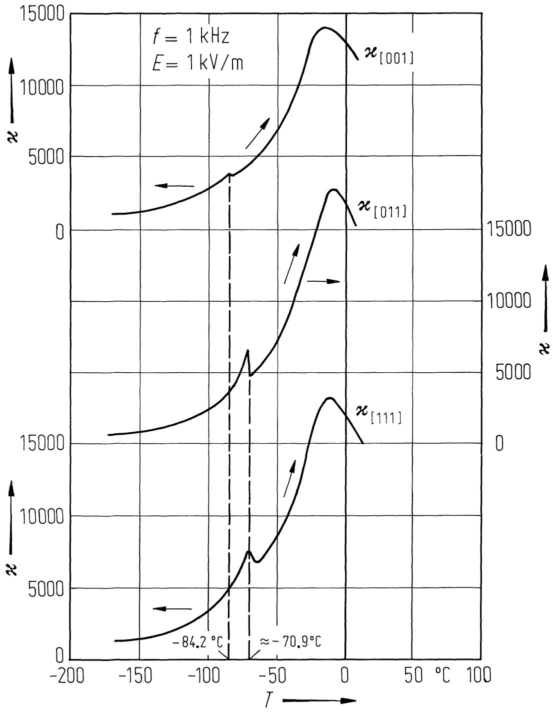

Fig. 1B-d4-009. $Pb(Mg_{1/3}Nb_{2/3})O_3$. $\kappa_{[001]}$, $\kappa_{[011]}$, $\kappa_{[111]}$ vs. T [80Sch]. f = 1 kHz.

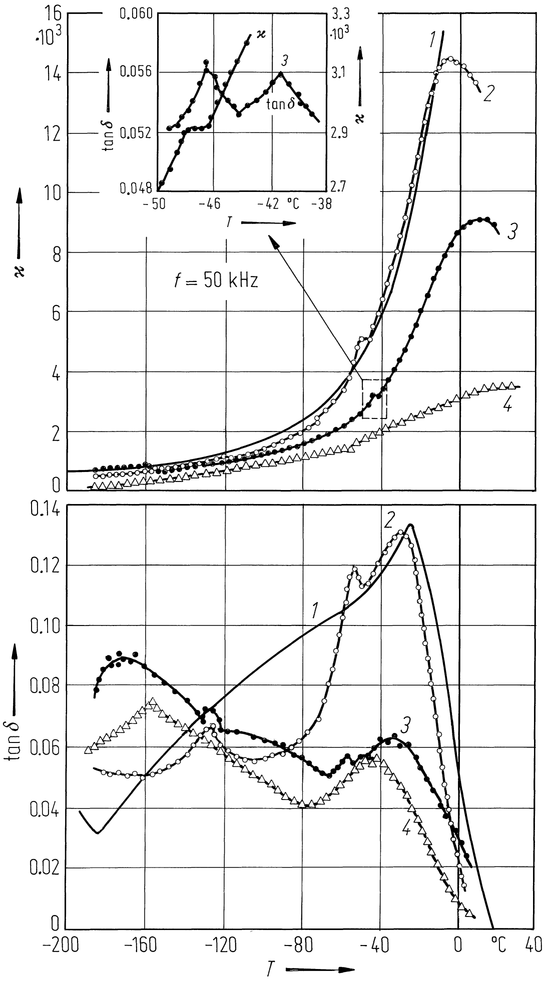

Fig. 1B-d4-010. $Pb(Mg_{1/3}Nb_{2/3})O_3$. κ, $\tan\delta$ vs. T along different directions and bias fields [81Smo]. Curve *1*: [100], E_{bias} = 0. *2*: [110], $E_{bias} = 6\cdot10^5$ Vm^{-1}. *3*: [111], $E_{bias} = 12\cdot10^5$ Vm^{-1}. *4*: [100], $E_{bias} = 12\cdot10^5$ Vm^{-1}.

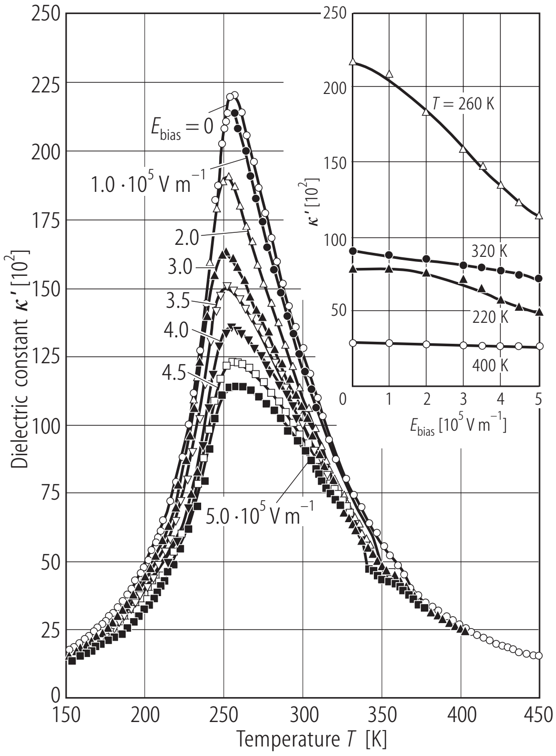

Fig. 1B-d4-011. $Pb(Mg_{1/3}Nb_{2/3})O_3$. $\kappa'_{[100]}$ vs. T [94Col]. Parameter: E_{bias}. Insert: $\kappa'_{[100]}$ vs. E_{bias}, parameter: T. f = 1.0 Hz.

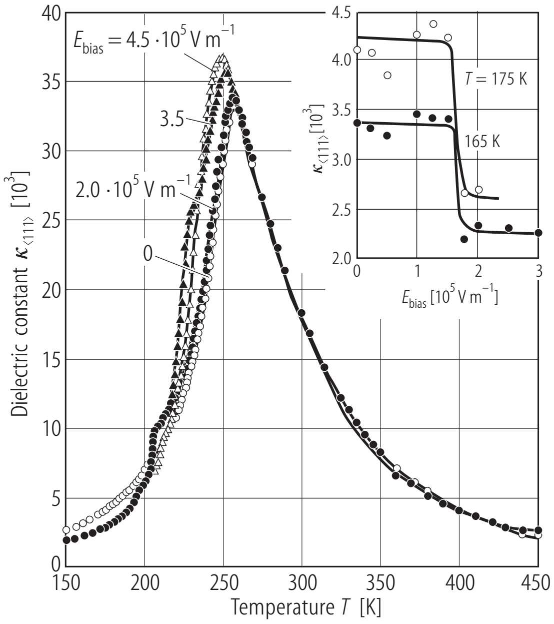

Fig. 1B-d4-012. $Pb(Mg_{1/3}Nb_{2/3})O_3$. $\kappa_{<111>}$ vs. T [94Col]. Parameter: E_{bias}. Insert: $\kappa_{<111>}$ vs. E_{bias}, parameter: T. f = 1.0 Hz.

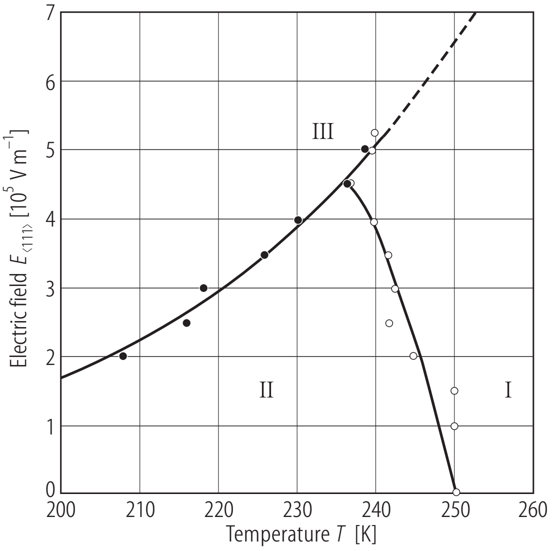

Fig. 1B-d4-013. Pb($Mg_{1/3}Nb_{2/3}$)O_3. $E_{<111>}$–T phase diagram [94Col].

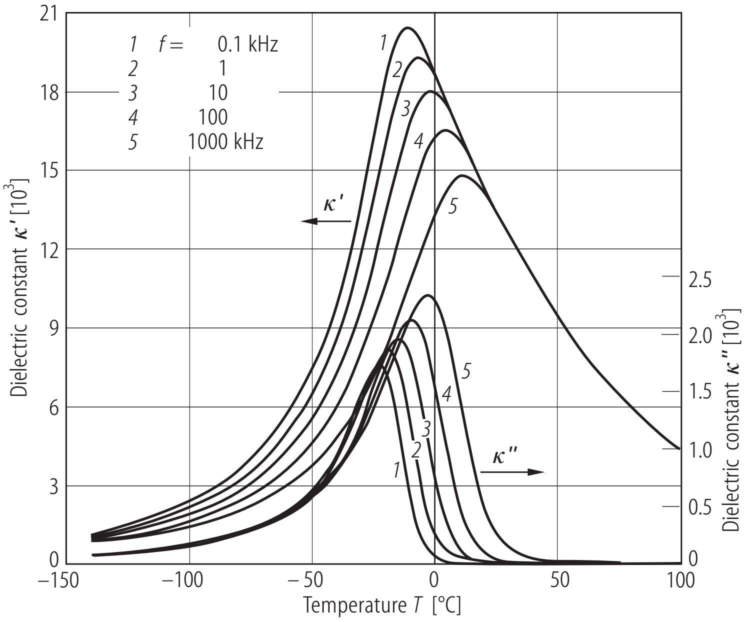

Fig. 1B-d4-014. Pb($Mg_{1/3}Nb_{2/3}$)O_3 (ceramics). κ' , κ'' vs. *T* [89But]. Parameter: *f*.

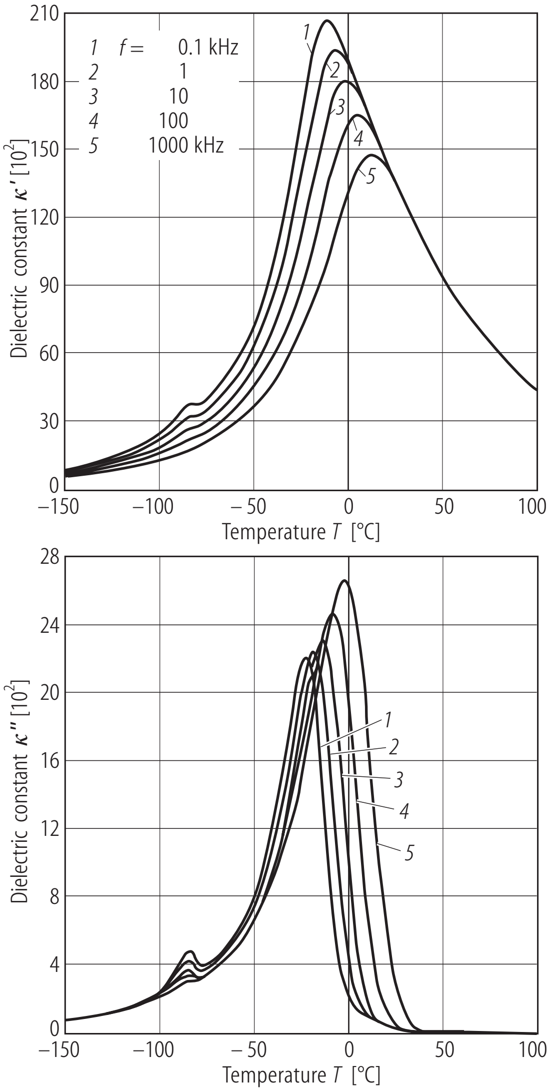

Fig. 1B-d4-015. $Pb(Mg_{1/3}Nb_{2/3})O_3$ (ceramics). κ', κ'' vs. *T* [89But]. Parameter: *f*. Poled crystal. $E_{pol} = 2 \cdot 10^6\ Vm^{-1}$.

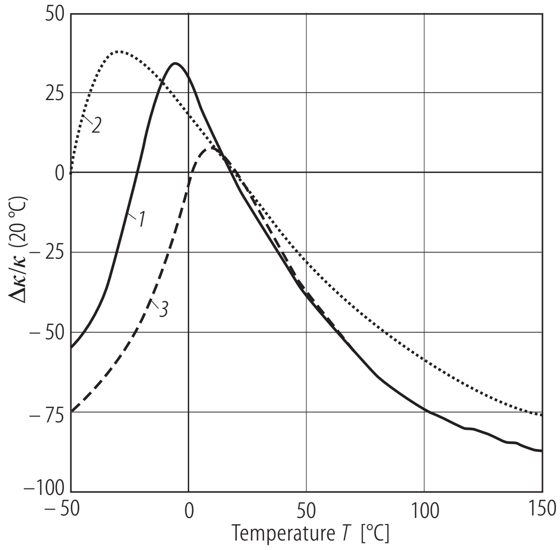

Fig. 1B-d4-016. $Pb(Mg_{1/3}Nb_{2/3})O_3$ (ceramics). $\Delta\kappa/\kappa$(20 °C) vs. *T* [91Dem]. Parameter: impurity content. $\Delta\kappa = \kappa(T) - \kappa$(20 °C). κ(20 °C): κ at 20 °C. Curve *1*: nondoped, *2*: doped with 1% La, *3*: doped with 3.75% Ti.

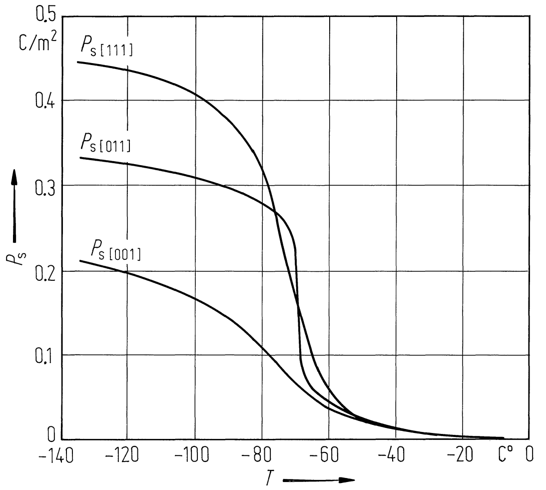

Fig. 1B-d4-017. $Pb(Mg_{1/3}Nb_{2/3})O_3$. $P_{s[hkl]}$ vs. T [80Sch]. $P_{s[hkl]}$: component of spontaneous polarization along the [hkl] direction.

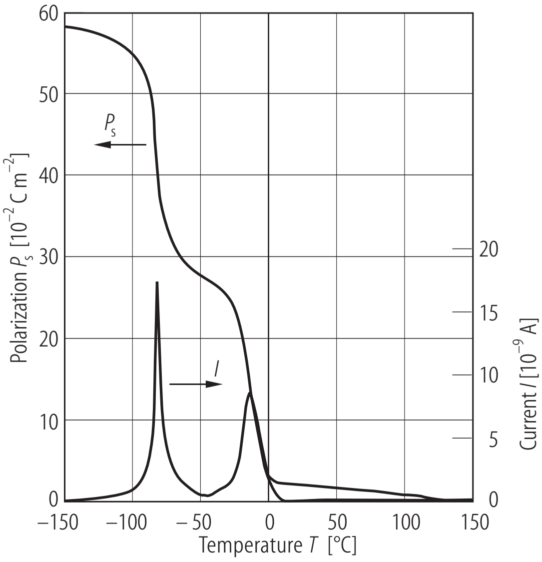

Fig. 1B-d4-018. $Pb(Mg_{1/3}Nb_{2/3})O_3$ (ceramics). P_s, I vs. T [89But]. I: pyroelectric current. $E_{pol} = 2\cdot10^6$ V m^{-1}. Heating rate is 1.0 °C min^{-1}.

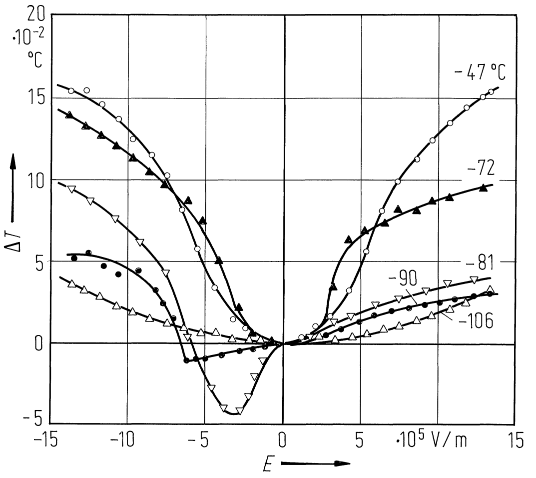

Fig. 1B-d4-019. Pb($Mg_{1/3}Nb_{2/3}$)O_3. Δ*T* vs. *E* [86She]. Δ*T*: electrocaloric temperature change. Parameter: *T*. *E*: external electric field along [321].

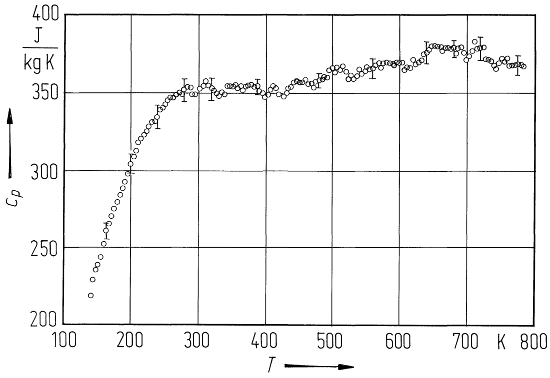

Fig. 1B-d4-020. $Pb(Mg_{1/3}Nb_{2/3})O_3$. c_p vs. T [81Fou]. c_p: specific heat capacity at constant pressure.

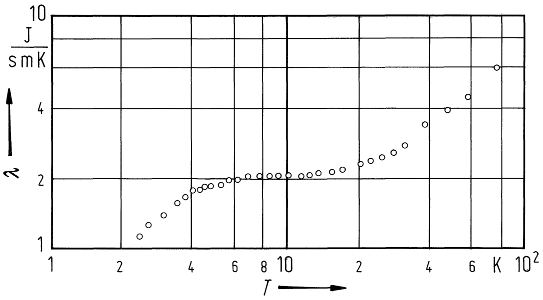

Fig. 1B-d4-021. $Pb(Mg_{1/3}Nb_{2/3})O_3$. λ vs. T [85Has].
λ: thermal conductivity.

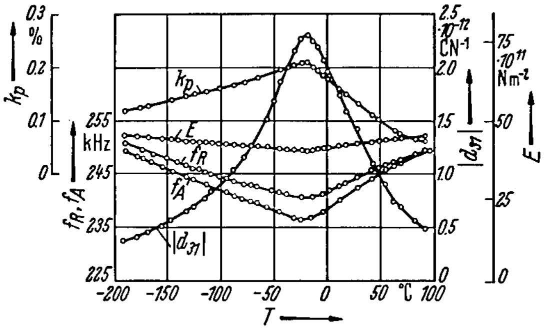

Fig. 1B-d4-022. Pb($Mg_{1/3}Nb_{2/3}$)O_3 (ceramics). f_R, f_A, E, d_{31}, k_p vs. T [60Smo]. f_R and f_A: resonant and antiresonant frequency in radial vibration, E: Young modulus.

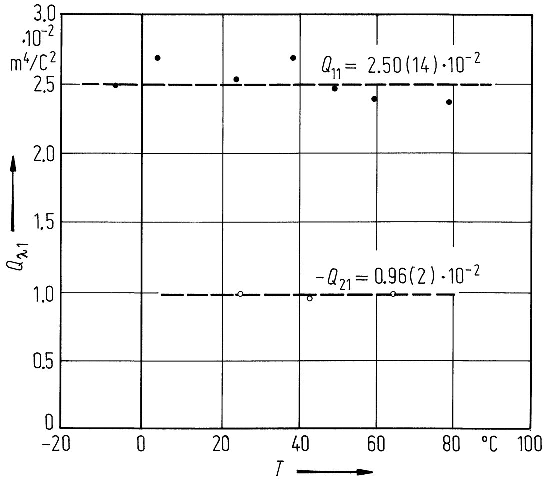

Fig. 1B-d4-023. $Pb(Mg_{1/3}Nb_{2/3})O_3$. Q_{11} , $-Q_{21}$ vs. T [80Uch]. $Q_{\lambda 1}$: electrostrictive constant.

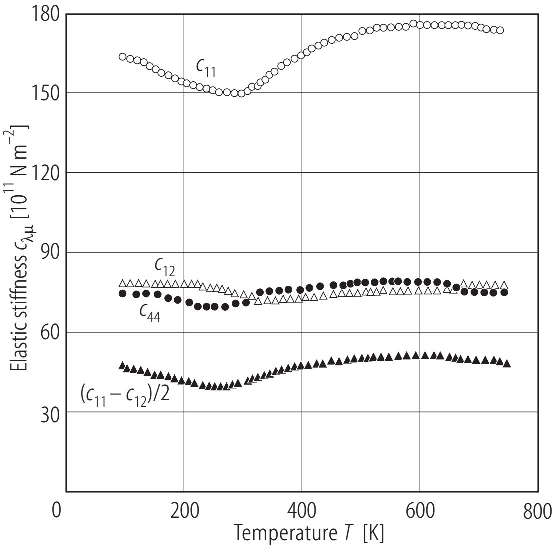

Fig. 1B-d4-024. Pb($Mg_{1/3}Nb_{2/3}$)O_3. c_{11}, c_{12} , c_{44}, $(c_{11} - c_{12})/2$ vs. T [90Yus].

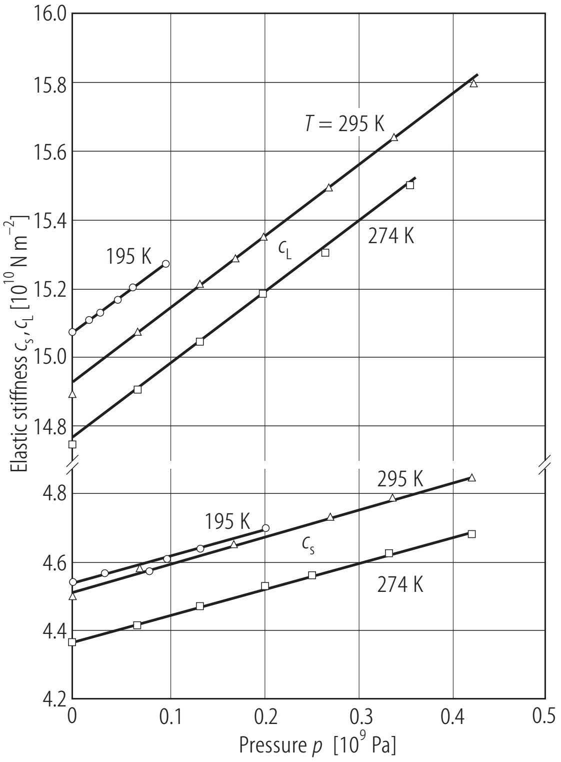

Fig. 1B-d4-025. $Pb(Mg_{1/3}Nb_{2/3})O_3$ (ceramics). c_L, c_s vs. p [87Mah]. c_L: longitudinal-wave elastic modulus. c_s: shear-wave elastic modulus. f = 10 MHz. Parameter: T.

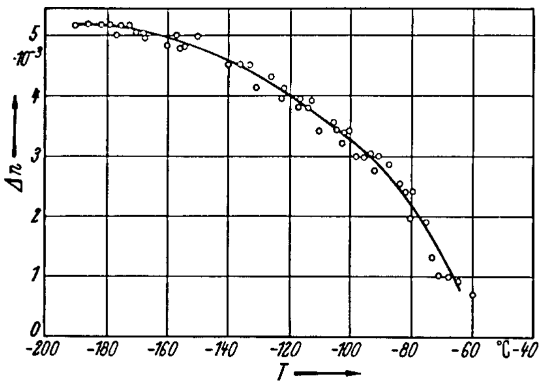

Fig. 1B-d4-026. $Pb(Mg_{1/3}Nb_{2/3})O_3$. Δn vs. T [61Bok]. In heating after having removed the applied electric field.

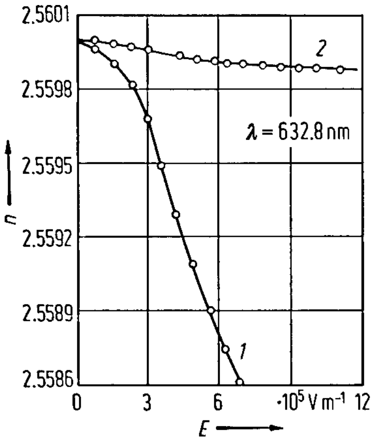

Fig. 1B-d4-027. $Pb(Mg_{1/3}Nb_{2/3})O_3$. *n* vs. *E* [71Ber]. Curve *1*: electric field parallel to the electric vector of light, *2*: electric field normal to the electric vector of light.

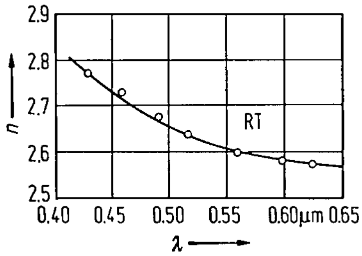

Fig. 1B-d4-028. Pb($Mg_{1/3}Nb_{2/3}$)O_3. *n* vs. λ [73Kam].

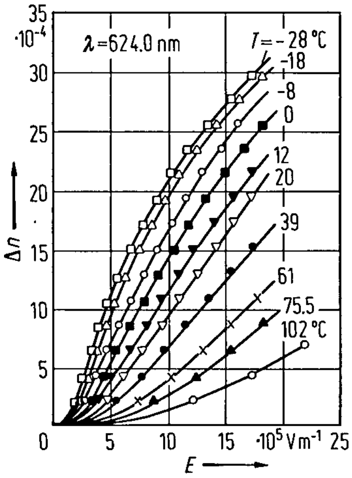

Fig. 1B-d4-029. $Pb(Mg_{1/3}Nb_{2/3})O_3$. Δ*n* vs. *E* [68Smo1]. Parameter: *T*. Light along [001], field along [100].

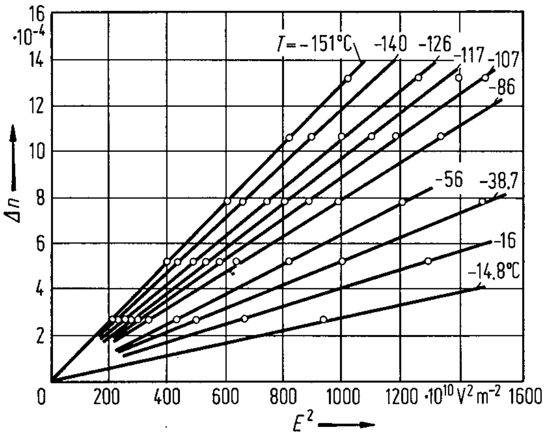

Fig. 1B-d4-030. $Pb(Mg_{1/3}Nb_{2/3})O_3$. Δn vs. E^2 [68Smo2]. Parameter: *T*. Light along [001], field along [100]. λ = 634 nm.

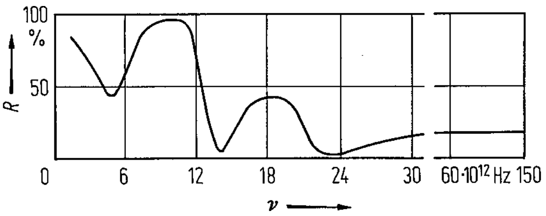

Fig. 1B-d4-031. $Pb(Mg_{1/3}Nb_{2/3})O_3$. *R* vs. *ν* [76Kar]. *R*: reflection.

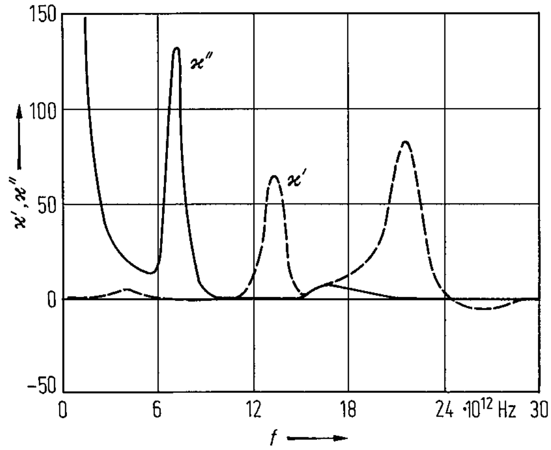

Fig. 1B-d4-032. Pb($Mg_{1/3}Nb_{2/3}$)O_3. *κ*' , *κ*'' vs. *f* [76Kar].

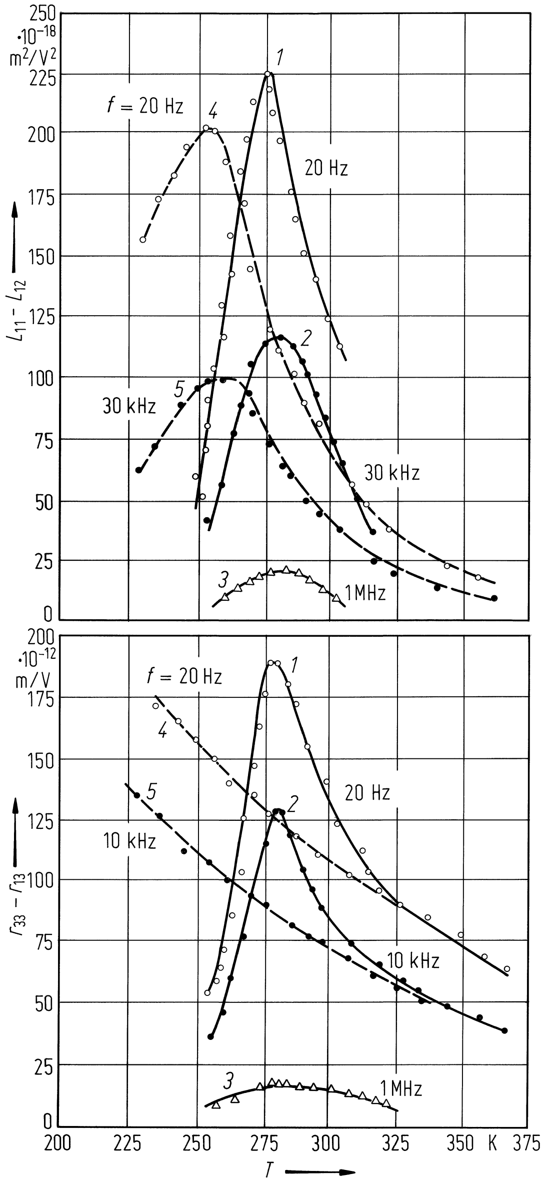

Fig. 1B-d4-033. $Pb(Mg_{1/3}Nb_{2/3})O_3$. $L_{11} - L_{12}$, $r_{33} - r_{13}$ vs. T [86Kam]. L_{11}, L_{12}: quadratic electrooptic constant for E. Curves *1*, *2*, *3*: measured in static bias fields; *4*, *5*: measured in alternating fields. Parameter: *f*.

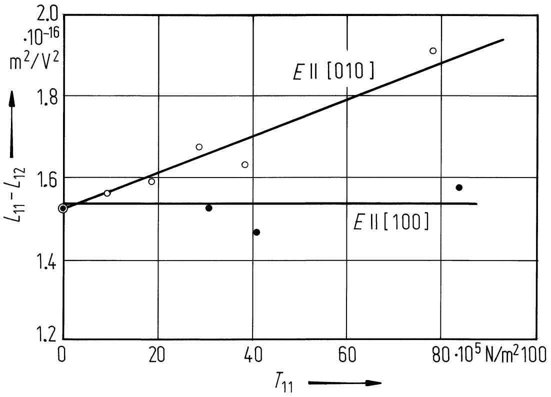

Fig. 1B-d4-034. $Pb(Mg_{1/3}Nb_{2/3})O_3$. $L_{11} - L_{12}$ vs. T_{11} [83Kuw]. L_{11}, L_{12}: quadratic electrooptic constant for *E*. T_{11}: compressional stress.

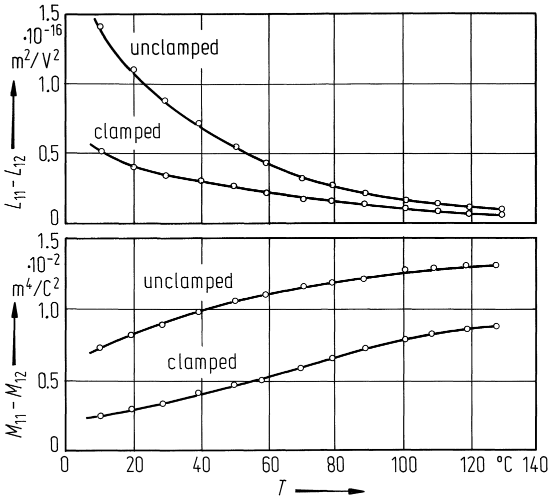

Fig. 1B-d4-035. $Pb(Mg_{1/3}Nb_{2/3})O_3$. $L_{11} - L_{12}$, $M_{11} - M_{12}$ vs. T [82Ozo]. $L_{\lambda\mu}$, $M_{\lambda\mu}$: quadratic electrooptic constants, $L_{\lambda\mu}$ for E, $M_{\lambda\mu}$ for P. λ = 633 nm.

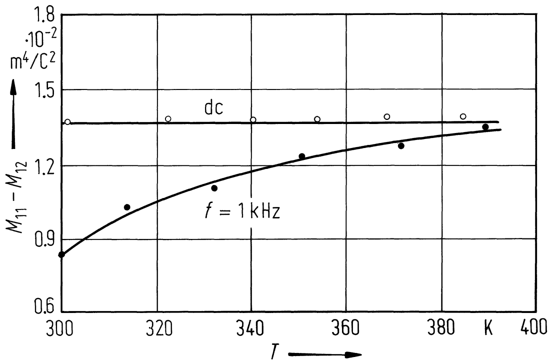

Fig. 1B-d4-036. $Pb(Mg_{1/3}Nb_{2/3})O_3$. $M_{11} - M_{12}$ vs. T [86Kam]. M_{11}, M_{12}: quadratic electrooptic constant for P.

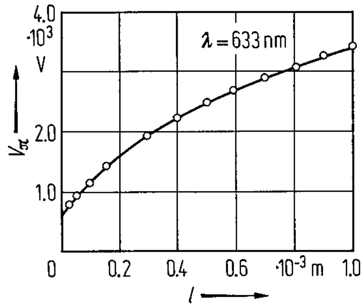

Fig. 1B-d4-037. $Pb(Mg_{1/3}Nb_{2/3})O_3$. V_π vs. l [72Ber]. V_π: half-wave voltage, l: thickness of the crystal. T = RT.

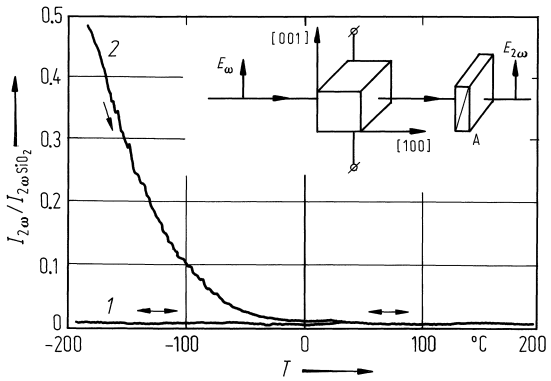

Fig. 1B-d4-038. $Pb(Mg_{1/3}Nb_{2/3})O_3$. $I_{2\omega}/I_{2\omega SiO_2}$ vs. T [80Lib]. $I_{2\omega}$: optical second harmonic intensity. $I_{2\omega SiO_2}$: $I_{2\omega}$ of SiO_2 standard. Curve *1*: polarized (at −100 °C, $E = 5{\cdot}10^2$ kV m^{-1}); *2*: depolarized. $\lambda = 1.06$ µm.

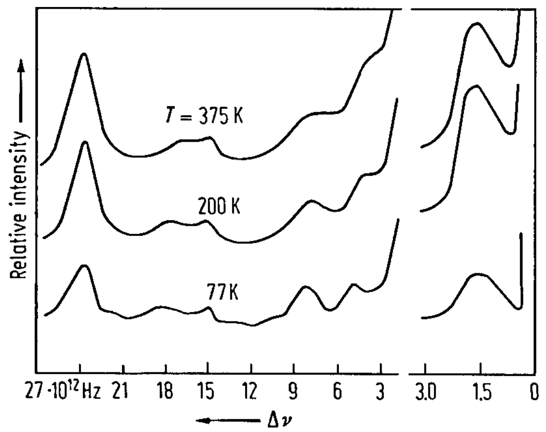

Fig. 1B-d4-039. $Pb(Mg_{1/3}Nb_{2/3})O_3$. Raman scattering spectra [73Kar]. Parameter: *T*.

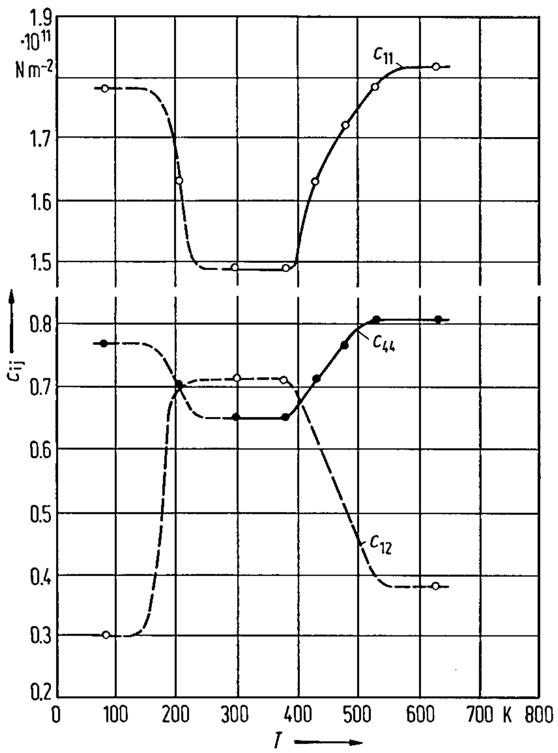

Fig. 1B-d4-040. Pb($Mg_{1/3}Nb_{2/3}$)O_3. c_{ij} vs. *T* [76Sie]. c_{ij}: elastic stiffnesses measured by Brillouin scattering.

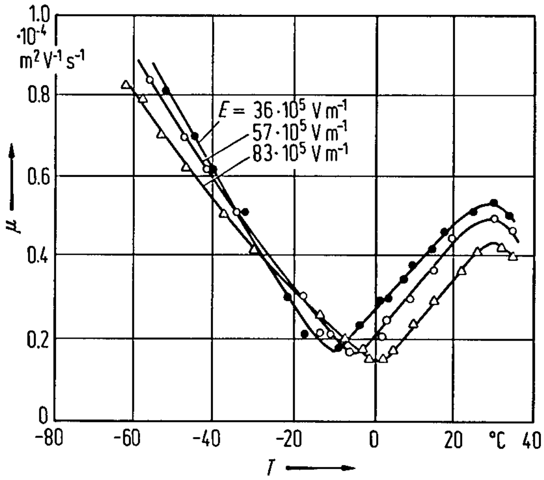

Fig. 1B-d4-041. $Pb(Mg_{1/3}Nb_{2/3})O_3$. μ vs. T [77Tre]. μ: electron drift mobility. E: applied field along [100] of thin crystal (≈10^2 μm thick).

References

58Smo Smolenskii, G.A., Agranovskaya, A.I.: Zh. Tekh. Fiz. **28** (1958) 1491; Sov. Phys. Tech. Phys. (English Transl.) **3** (1958) 1380.

59Myl Myl'nikova, I.E., Bokov, V.A.: Kristallografiya **4** (1959) 433; Sov. Phys. Crystallogr. (English Transl.) **4** (1959) 408.

59Smo Smolenskii, G.A., Agranovskaya, A.I.: Fiz. Tverd. Tela **1** (1959) 1562; Sov. Phys. Solid State (English Transl.) **1** (1959) 1429.

60Ism Ismailzade, I.G.: Krisallografiya **5** (1960) 316; Sov. Phys. Crystallogr. (English Transl.) **5** (1960) 292.

60Smo Smolenskii, G.A., Isupov, V.A., Agranovskaya, A.I., Popov, S.N.: Fiz. Tverd. Tela **2** (1960) 2906; Sov. Phys. Solid State (English Transl.) **2** (1961) 2584.

61Bok Bokov, V.A., Myl'nikova, I.E.: Fiz. Tverd. Tela **3** (1961) 841; Sov. Phys. Solid State (English Transl.) **3** (1961) 613.

65Ouc Ouchi, H., Nagano, K., Hayakawa, S.: J. Am. Ceram. Soc. **48** (1965) 630.

67Bon1 Bonner, W.A., Van Uitert, L.G.: Mater. Res. Bull. **2** (1967) 131.

67Bon2 Bonner, W.A., Dearborn, E.F., Geusic, J.E., Marcos, H.M., Van Uitert, L.G.: Appl. Phys. Lett. **10** (1967) 163.

68Smo1 Smolenskii, G.A., Krainik, N.N., Berezhnoi, A.A., Myl'nikova, I.E.: Fiz. Tverd. Tela **10** (1968) 467; Sov. Phys. Solid State (English Transl.) **10** (1968) 365.

68Smo2 Smolenskii, G.A., Krainik, N.N., Berezhnoi, A.A., Myl'nikova, I.E.: Fiz. Tverd Tela **10** (1968) 2675; Sov. Phys. Solid State (English Transl.) **10** (1969) 2105.

71Ber Berezhnoi, A.A.: Opt. Spektrosk. **31** (1971) 803; Opt. Spectrosc. (English Transl.) **31** (1971) 432.

72Ber Berezhnoi, A.A.: Fiz. Tverd. Tela **14** (1972) 2576; Sov. Phys. Solid State (English Transl.) **14** (1973) 2230.

73Kam Kamzina, L.S., Krainik, N.N., Berezhnoi, A.A.: Fiz. Tverd. Tela **15** (1973) 3011; Sov. Phys. Solid State (English Transl.) **15** (1974) 2006.

73Kar Karamyan, A.A., Krainik, N.N.: Fiz. Tverd. Tela **15** (1973) 2534; Sov. Phys. Solid State (English Transl.) **15** (1974) 1687.

74Smo Smoleskii, G.A., Trepakov, V.A., Krainik, N.N.: Zh. Eksp. Teor. Fiz. Pis'ma Red. **20** (1974) 322; JETP Lett. (English Transl.) **20** (1974) 99.

76Kar Karamyan, A.A.: Fiz. Tverd. Tela **18** (1976) 3168; Sov. Phys. Solid State (English Transl.) **18** (1976) 1851.

76Sie Siegwarth, J.D., Holste, J.C., Morrow, A.J.: J. Appl. Phys. **47** (1976) 4791.

76Tre Trepakov, V.A., Krainik, N.N., Olifir, A.V.: Fiz. Tverd. Tela. **18** (1976) 1751; Sov. Phys. Solid State (English Transl.) **18** (1976) 1019.

77Smo Smolenskii, G.A., Prokhorova, S.D., Sinii, I.G., Chernyshova, E.O.: Izv. Akad. Nauk SSSR, Ser. Fiz. **41** (1977) 611; Bull. Acad. Sci. USSR, Phys. Ser. (English Transl.) **41** (1977) 125.

77Tre Trepakov, V.A., Babinskii, A.V., Krainik, N.N., Smolenskii, G.A., Samukhin, A.N.: Zh. Eksp. Teor. Fiz. Pis'ma Red. **26** (1977) 473; JETP Lett. (English Transl.) **26** (1977) 341.

79Fri Fritsberg, V.Ya., Fritsberg, P.A.: Krisallografia **24** (1979) 856; Sov. Phys. Crystallogr. (English Transl.) **24** (1979) 492.

80Lib Liberts, G.V.: Phys. Status Solidi (a) **61** (1980) K43.

80Sch Schmidt, G., Arndt, H., v. Cieminski, J., Petzsche, T., Vogt, H.-J., Krainik, N.N.: Krist. Tech. **15** (1980) 1415.

80Uch Uchino, K., Nomura, S., Cross, L.E., Jang, S.J., Newnham, R.E.: J. Appl. Phys. **51** (1980) 1142.

80Zvi Zvirgzds, J.A., Zajanckovskis, Z.B., Birks, E.H., Zvirgzde, J.V.: Krist. Tech. **15** (1980) K99.

81Fou Fousková, A., Kohl, V., Krainik, N.N., Myl'nikova, I.E.: Ferroelectrics **34** (1981) 119.

81Set Setter, N., Cross, L.E.: Ferroelectrics **37** (1981) 551.

81Smo Smolenskii, A.G., Krainik, N.N., Kamzina, L.S., Kuznetsova, L.A.: Pis'ma Zh. Tekh. Fiz. **7** (1981) 90; Sov. Tech. Phys. Lett. (English Transl.) **7** (1981) 38.
82Ozo Ozolinsh, M.: Mater. Res. Bull. **17** (1982) 741.
82Swa Swartz, S.L., Shrout, T.R.: Mater. Res. Bull. **17** (1982) 1245.
83Kor Korshunov, O.Yu., Markovin, P.A., Pisarev, R.V.: Fiz. Tverd. Tela **25** (1983) 2134; Sov. Phys. Solid State (English Transl.) **25** (1983) 1228.
83Kra Krainik, N.N., Kamzina, L.S., Smolenskii, G.A.: Fiz. Tverd. Tela **25** (1983) 359; Sov. Phys. Solid State (English Transl.) **25** (1983) 202.
84Ber Berezhnoi, A.A., Popov, Yu.V.: Opt.-Mekh. Prom. **51** (1984) 52; Sov. J. Opt. Technol. (English Transl.) **51** (1984) 684.
84Swa Swartz, S.L., Shrout, T.R., Schulze, W.A., Cross, L.E.: J. Am. Ceram. Soc. **67** (1984) 311.
85Has Hässler, W., Hegenbarth, E.: Ferroelectrics Lett. **4** (1985) 117.
85Pop Poplavko, Yu.M., Bovtun, V.P., Krainik, N.N., Smolenskii, G.A.: Fiz. Tverd. Tela **27** (1985) 3161; Sov. Phys. Solid State (English Transl.) **27** (1985) 1903.
85Ros Rossignol, J.F., Simon, A., Ravez, J., Hagenmuller, P.: Ann. Chim. Sci. Mater. **10** (1985) 21.
86Kam Kamzina, L.S., Krainik, N.N., Smolenskii, G.A.: Avtometriya **2** (1986) 9; Optoelectron., Instrum. Data Process. (English Transl.) **2** (1986) 8.
86She Shebanov, L.A., Kapostin'sh, P.P., Birks, E.Kh., Zvirgzds, Yu.A.: Kristallografiya **31** (1986) 317; Sov. Phys. Crystallogr. (English Transl.) **31** (1986) 187.
87Mah Maheswaranathan, P., Sladek, R.: Phys. Rev. B **35** (1987) 3369.
88Kan Kang, D.H., Yoon, K.H.: Ferroelectrics **87** (1988) 255.
89But Butcher, S.J., Daglish, M.: Ferroelectrics Lett. **10** (1989) 117.
89Che Chen, J., Chan, H.M., Harmer, M.P.: J. Am. Ceram. Soc. **72** (1989) 593.
89Lan Lanagan, M.T., Yang, N., Dube, D.C., Jang, S.-J.: J. Am. Ceram. Soc. **72** (1989) 481.
89Yan1 Yan, M.F., Ling, H.C., Rhodes, W.W.: J. Mater. Res. **4** (1989) 930.
89Yan2 Yan, M.F., Ling, H.C., Rhodes, W.W.: J. Mater. Res. **4** (1989) 945.
90Pap Papet, P., Dougherty, J.P., Shrout, T.R.: J. Mater. Res. **5** (1990) 2902.
90Ran Randall, C.R., Bhalla, A.S.: Jpn. J. Appl. Phys. **29** (1990) 327.
90Yus Yushin, N.K., Dorogovtsev, S.N.: Izv. Akad. Nauk SSSR, Ser. Fiz. **54** (1990) 629; Bull. Acad. Sci. USSR, Phys. Ser. **54** No. 4 (1990) 30.
91deM de Mathan, N., Husson, E., Morell, A.: Euro-Ceramics II, Vol. 3, 1991, p. 2017.
91Oku Okuwada, K., Nakamura, S., Imai, M., Kakuno, K.: Jpn. J. Appl. Phys. **30** (1991) L1052.
91Vie Viehland, D., Jang, D., Cross, L.E.: Philos. Mag. B **64** (1991) 335.
92Col Colla, E.V., Koroleva, E.Yu., Okuneva, N.M., Vakhrushev, S.B: J. Phys. Condens. Matter **4** (1992) 3671.
92Uda Udayakumar, K.R., Chen, J., Schuele, P.J., Cross, L.E., Kumar, V., Krupanidhi, S.B.: Appl. Phys. Lett. **60** (1992) 1187.
92Wes Westphal, V., Kleeman, W., Glinchuk, M.D.: Phys. Rev. Lett. **68** (1992) 847.
93EoK Eo, K., Choo, W.K.: Ferroelectrics **138** (1993) 79.
93YeZ Ye, Z.-G., Schmid, H.: Ferroelectrics **145** (1993) 83.
94Chr Christen, H.M., Sommer, R., Yushin, N.K., van der Klink, J.J.: J. Phys. Condens. Mater **6** (1994) 2631.
94Col Colla, E.V., Koroleva, E.Yu., Nobereznov, A.A., Okuneva, N.M.: Ferroelectrics **151** (1994) 337.
94Eli Elissalde, C., Ravez, J.: Phys. Status Solidi (a) **142** (1994) 291.
94Par Park, K., Salamanca-Riba, L., Wutting, M.: J. Mater. Sci. **29** (1994) 1284.
95Bur Bursill, L.A., Qian, H., Peng, J.-L., Fan, X.D.: Physica B **216** (1995) 1.