No. 1B-d5 $Pb(Zn_{1/3}Nb_{2/3})O_3$
(M = 338.9)

1a Ferroelectricity in $Pb(Zn_{1/3}Nb_{2/3})O_3$ with perovskite structure was found by Bokov and Myl'nikova in 1960. 60Bok

b

phase	II	I
state	F	P
crystal system	rhombohedral	cubic
space group	$3m - C_{3v}$	$Pm3m - O_h^1$
Θ [°C]	140 (average)	

70Yok

This transition is a diffuse phase transition smeared around 140 °C.
P_s || [111] in phase II. 70Yok
Color: light yellow. 60Bok

2a Crystal growth: flux growth with PbO. 60Bok
Stability under various p and T: Fig. 1B-d5-001.
Although perovskite $Pb(Zn_{1/3}Nb_{2/3})O_3$ single crystals can be synthesized, ferroelectric PZN ceramics of perovskite-type can not be prepared by the usual solid state reaction method. The perovskite compound is synthesized under the conditions of 2.5 GPa and 800...1000 °C. 70Mat, 71Kra

3a Unit cell parameters: a = 4.061(1) Å, $\alpha = 89^o55'$ at RT. 70Yok

4 Lattice parameters: Fig. 1B-d5-002.
Thermal expansion: Fig. 1B-d5-003.

5a Dielectric constant: Fig. 1B-d5-004.
Effect on E_{bias} on κ: see 70Yok, 94Kam

Effect of p on κ: Fig. 1B-d5-005.

c Spontaneous polarization: Fig. 1B-d5-006.

d Pyroelectricity: Fig. 1B-d5-007.
$p_{[111]} = 7 \cdot 10^{-4}\ Cm^{-2}K^{-1}$ at RT.

7a Piezoelectricity: $k_{33} \approx 0.4$. 69Yon

b Electrostriction: $Q_{11} = 2.4 \cdot 10^{-2}\ m^4C^{-2}$, $Q_{12} = -0.86 \cdot 10^{-2}\ m^4C^{-2}$, $Q_h = 0.66 \cdot 10^{-2}\ m^4C^{-2}$. 79Nom1

8a Elastic stiffness: $c_{11} = 13.1 \cdot 10^{10}\ Nm^{-2}$, $c_{44} = 5.6 \cdot 10^{10}\ Nm^{-2}$ at RT. 80Uch

9a Refractive index: Fig. 1B-d5-008.
Birefringence: Figs. 1B-d5-009...1B-d5-011.

b Electrooptic effect: $r_{33} - r_{13} = 700 \cdot 10^{-12}\ mV^{-1}$ (λ = 633 nm) in the ferroelectric region, see also Fig. 1B-d5-012.
$M_{44} = 0.55 \cdot 10^{-2}\ m^4C^{-2}$ (λ = 633 nm), see also Fig. 1B-d5-013. 77Koj

15a Domain structure: The annealed crystal discloses irregular patterns of micro-domains about 1 µm in size. Etchant for revealing domain structure: 10% HF or 5% H_3PO_4. 74Nom
See also 95Mul
Domain switching: Fig. 1B-d5-014, Fig. 1B-d5-015.

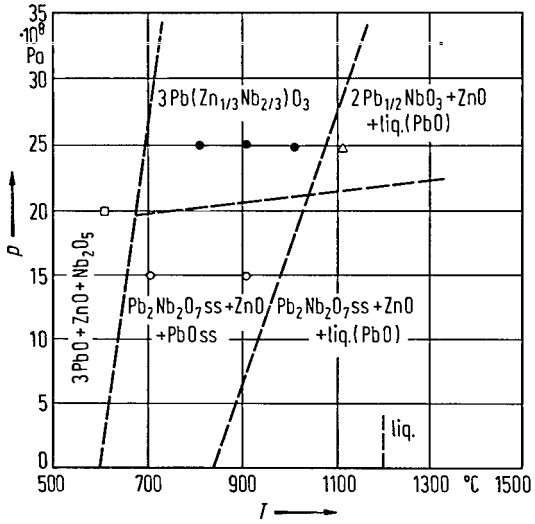

Fig. 1B-d5-001. $Pb(Zn_{1/3}Nb_{2/3})O_3$. Stability of compound formed from a mixture of $3PbO+ZnO+Nb_2O_5$ under various *p* and *T* [70Mat]. Square: no reaction; full circles: perovskite phase; open circles: pyrochlore phase; triangle: tungsten bronze phase.

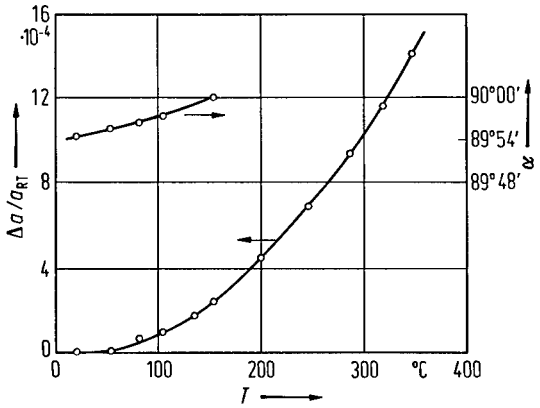

Fig. 1B-d5-002. $Pb(Zn_{1/3}Nb_{2/3})O_3$. Lattice parameters a, α vs. T [75Nom]. Δa: $a - a_{RT}$.

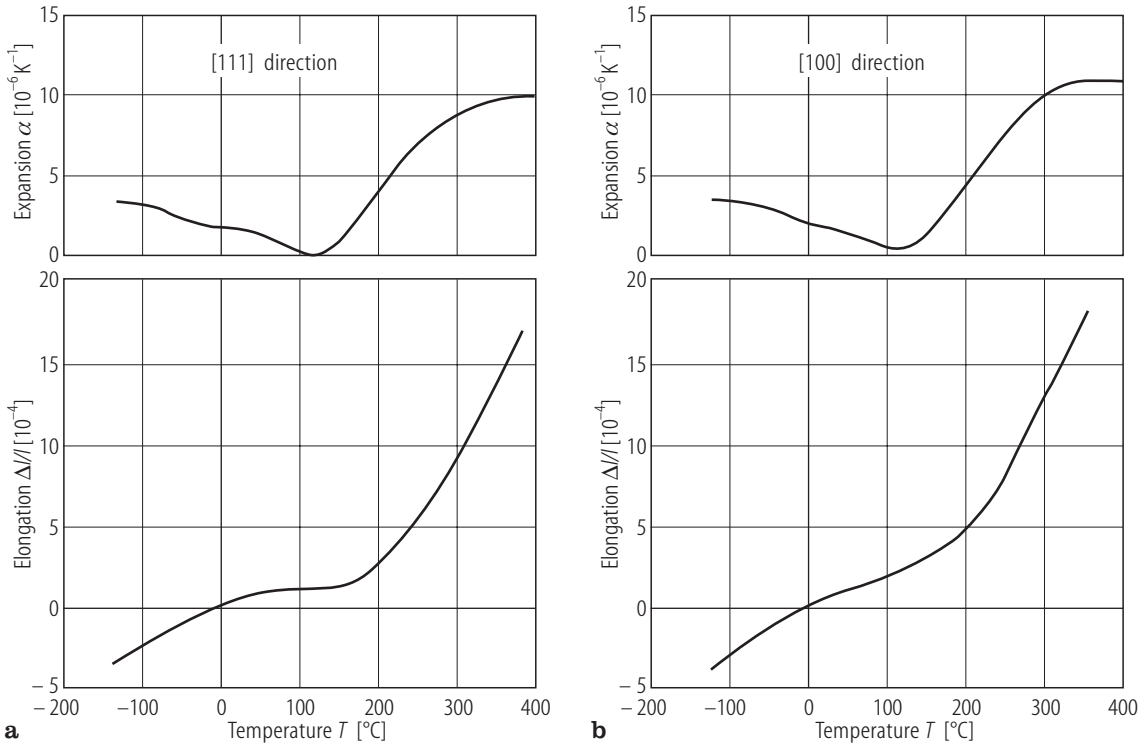

Fig. 1B-d5-003. $Pb(Zn_{1/3}Nb_{2/3})O_3$. $\Delta l/l$, α vs. T [75Nom]. **(a)**: [111] direction. **(b)**: [100] direction. $\Delta l/l$ and α: linear thermal expansion and its temperature coefficient.

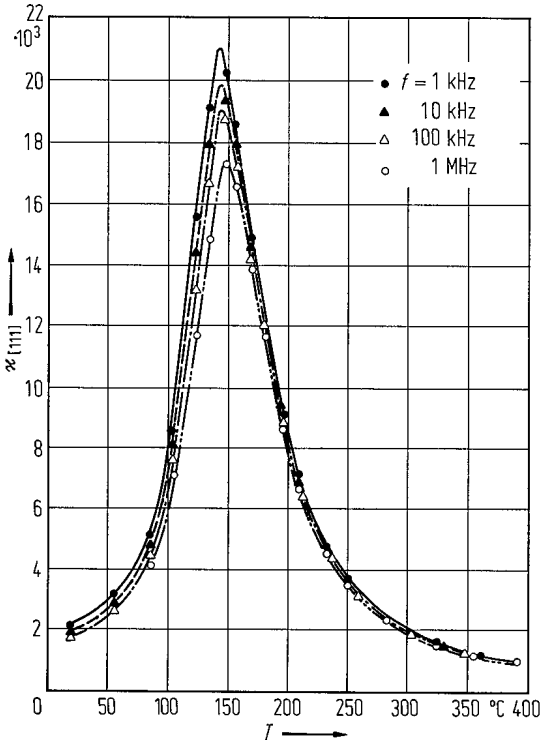

Fig. 1B-d5-004. $Pb(Zn_{1/3}Nb_{2/3})O_3$. $\kappa_{[111]}$ vs. T [79Nom2]. Parameter: f.

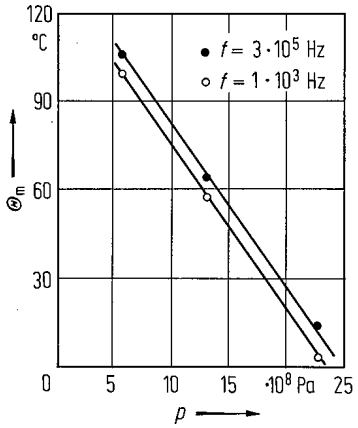

Fig. 1B-d5-005. $Pb(Zn_{1/3}Nb_{2/3})O_3$. Θ_m vs. p [71Yos].
Parameter: f. Θ_m: peak temperature of κ.

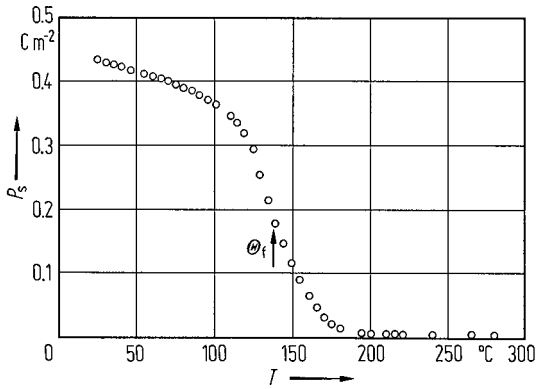

Fig. 1B-d5-006. $Pb(Zn_{1/3}Nb_{2/3})O_3$. P_s vs. T [77Koj].

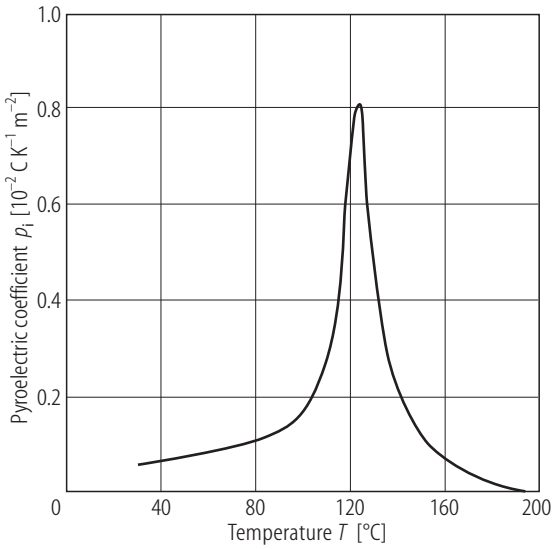

Fig. 1B-d5-007. $Pb(Zn_{1/3}Nb_{2/3})O_3$. p_i vs. T [80Nom]. p_i: pyroelectric coefficient along the [111] axis.

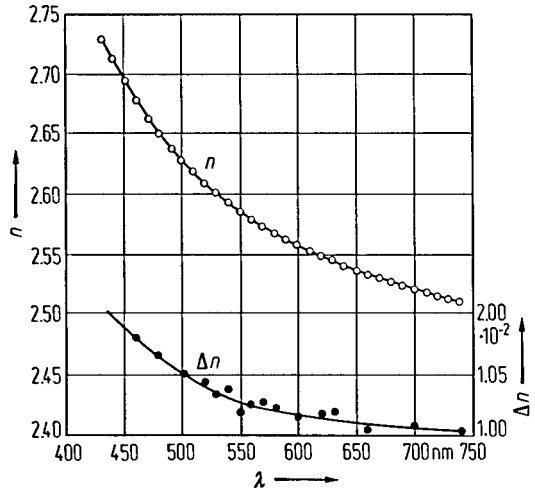

Fig. 1B-d5-008. $Pb(Zn_{1/3}Nb_{2/3})O_3$. n, Δn vs. λ [77Koj].

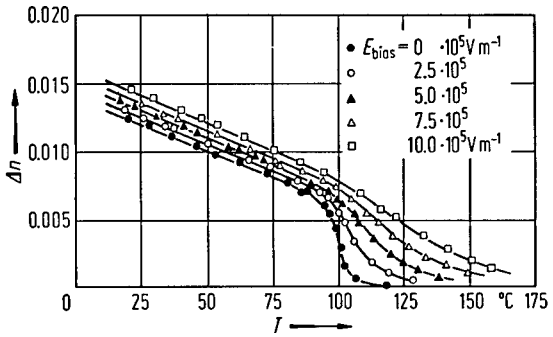

Fig. 1B-d5-009. $Pb(Zn_{1/3}Nb_{2/3})O_3$. Δn vs. T [70Yok]. Parameter: E_{bias}. E_{bias}: dc bias field.

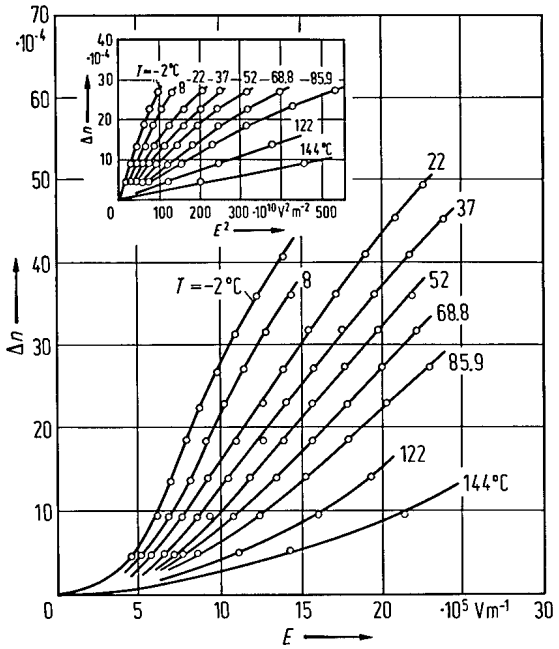

Fig. 1B-d5-010. $Pb(Zn_{1/3}Nb_{2/3})O_3$. Δn vs. E, Δn vs. E^2 [68Smo]. Parameter: T. Light along [001], field along [100]. λ = 624 nm.

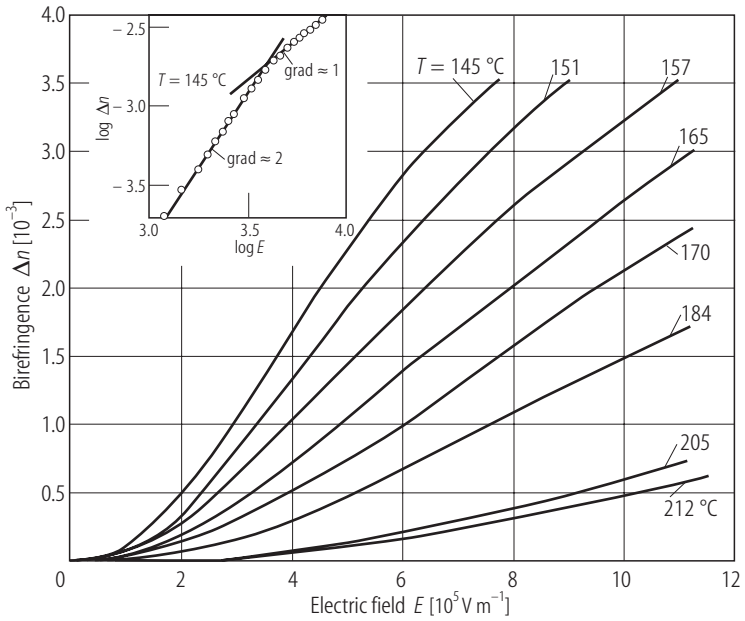

Fig. 1B-d5-011. $Pb(Zn_{1/3}Nb_{2/3})O_3$. Δn vs. E [79Kuw]. Parameter: T. Insert: log Δn vs. log E.

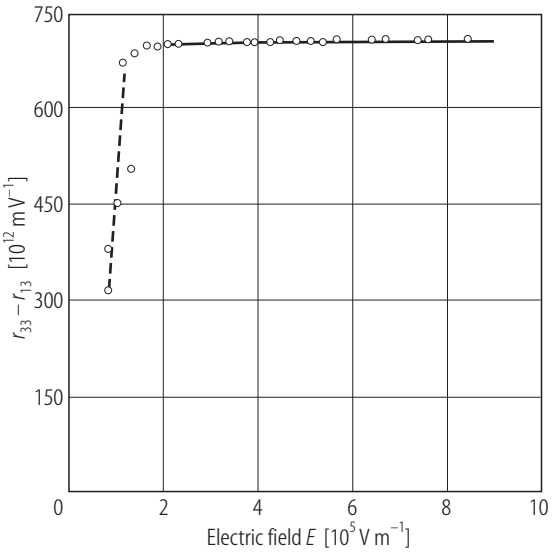

Fig. 1B-d5-012. $Pb(Zn_{1/3}Nb_{2/3})O_3$. $r_{33} - r_{13}$ vs. E [77Koj]. r_{ij}: linear electrooptic constant for E.

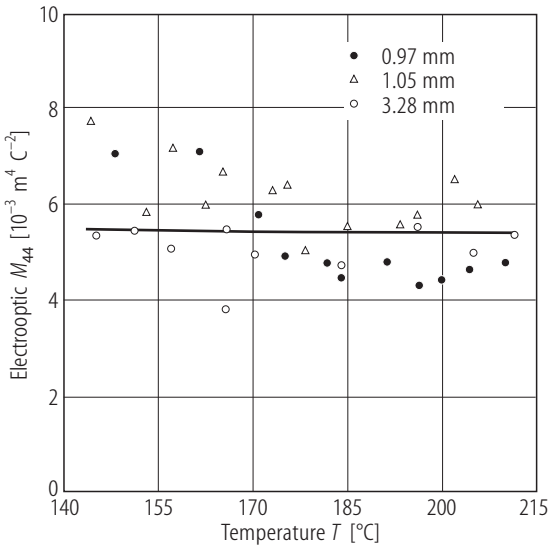

Fig. 1B-d5-013. $Pb(Zn_{1/3}Nb_{2/3})O_3$. M_{44} vs. T [77Koj].
M_{ij}: quadratic electrooptic constant for P.

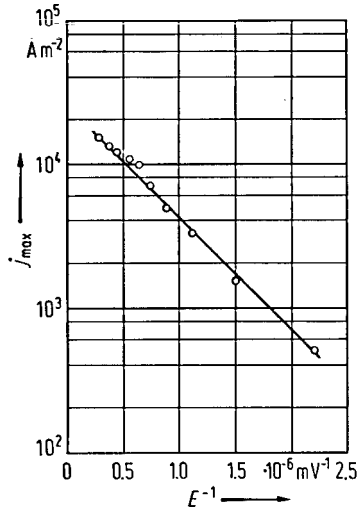

Fig. 1B-d5-014. $Pb(Zn_{1/3}Nb_{2/3})O_3$. j_{max} vs. E^{-1} [74Nom].
j_{max}: maximum switching current density, E || [111].

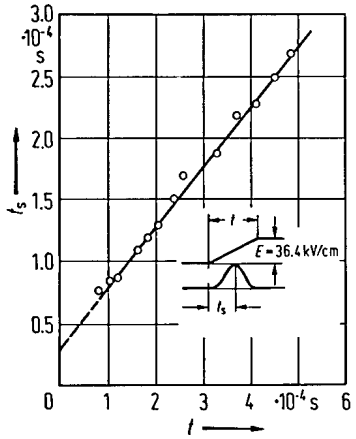

Fig. 1B-d5-015. $Pb(Zn_{1/3}Nb_{2/3})O_3$. t_s vs. t [74Nom]. t_s: switching time, t: pulse width. $E = 36.4 \cdot 10^5\ V m^{-1}$.

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