No. 1A-10 $BaTiO_3$, Barium titanate
(M = 233.15)

At about 1460 °C in air, cubic $BaTiO_3$ performs a transition to hexagonal phase. The reverse transition from the hexagonal to the cubic phase is very sluggish and the hexagonal form can be quenched into a practically stable state by relatively rapid cooling, especially in reducing atmosphere. Accordingly, there are two prototype structures of $BaTiO_3$ at room temperature: so-called cubic $BaTiO_3$ and hexagonal $BaTiO_3$. In this section, their data are presented separately as (i) cubic $BaTiO_3$ and (ii) hexagonal $BaTiO_3$.

(i) Cubic $BaTiO_3$

1a The anomalous dielectric properties of $BaTiO_3$ were discovered on ceramic specimens independently by Wainer and Solomon in 1942, by Ogawa in 1944 and by Wul in 1945. The ferroelectric activity of $BaTiO_3$ was reported independently by von Hippel and co-workers in 1944 and by Wul in 1946. The structural change associated with the cubic-tetragonal phase transition was observed, by means of X-rays, by Megaw in-dependently of the above dielectric studies. 42Wai, 44Oga, 45Wul, 44von, 46Wul1, 45Meg

b

phase	IV [a]	III [a]	II [b]	I [b]		[a]) 49Kay,
state	F [a]	F [a]	F [b]	P [b]		49Rho
crystal system	rhombo-hedral [a]	ortho-rhombic [a]	tetragonal [b]	cubic [b]	hexagonal [d])[**]	[b]) 45Meg [c]) 46von,
space group	$R3m - C_{3v}^5$ [a]	$Amm2 - C_{2v}^{14}$ [a]	$P4mm - C_{4v}^1$ [b]	$Pm3m - O_h^1$ [b]	$P6_3/mmc - D_{6h}^4$ [d]	46Wul2 [d]) 55Ras [e]) 95Sak
Θ [°C]	–90 [a]		5 [a]	123 [e])[*]	1460 [d]	

[*]) In most papers published earlier, the Curie point was reported to be about 120 °C. It was, however, reported to be about 130 °C in Ti-rich $BaTiO_3$ [95Sak], as was observed in $BaTiO_3$ single crystal pulled from Ti-rich melt [65Joh1].

[**]) The hexagonal form can be produced by rapid cooling from about 1460 °C in air. The transition temperature lowers to 1330 °C in a hydrogen atmosphere [60Gla], [69Are].

P_s || [001] in phase II (along [100] of phase I).
P_s || [001] in phase III (along [110] of phase I).
P_s || [001] in phase IV (along [111] of phase I).
The directions of P_s are illustrated along with lattice distortions in Fig. 1A-10-001. 66Car
T_{melt} = 1620 °C. 91Kir
Tetragonal form (phase II): $\rho = 6.02 \cdot 10^3$ kg m^{-3} (calculated from lattice constants): 51Rho
see 71Bel
Transparent, light brown, straw-yellow color.

2a Crystal growth:
1) flux method (flux KF [a]) or TiO_2-rich melt [b])); see [a]) 54Rem [b]) 65Sas, 67Bra

2) pulling method (top-seeded solution growth technique using excess TiO_2 as the solvent); see 71Bel, 88Sch1, 92Aji

3) floating zone method (containing 3 mol% $SrTiO_3$); see 72Tie

4) solid-state grain growth method; see 94Yam2

Phase diagram of $BaO–TiO_2$ system: Fig. 1A-10-002, Fig. 1A-10-003.
Solubility of $BaTiO_3$ in KF: Table 1A-10-001.

Thin film growth:

1) vacuum evaporation; see 80Toc, 80Tom, 81Sev, 83Toc, 85Iij, 90Iij

2) sol-gel method; see 81Yan, 90Yok, 93Kuw, 93Hay

3) screen printing or electrophoresis and annealing; see 79Sur, 80Sur, 80Yam, 80Lop

4) sputtering method; see 79Pan, 80Pan, 81Dud1, 81Dud2, 81Ols, 79McC, 79Sur, 82Dha, 83Dha, 81Nag, 91Kle, 91Kaw

5) pulsed-laser deposition or laser ablation; see 89Dav, 91Nor, 92Roy, 93Kor, 93Nas, 94Wat

6) chemical vapor deposition; see 92Che, 91Nak, 91Kwa, 92Van, 93Kim, 94Kim, 95Kaw

7) hydrothermal method; see 90Ish, 91Kaj

8) molecular beam epitaxy; see 91McK

b	Crystal forms: for butterfly type, Fig. 1A-10-004; for chunky type, Fig. 1A-10-005.	
3a	Unit cell parameters: phase I: a = 3.996 Å at 120°C. phase II: a = 3.9920 Å, c = 4.0361 Å at 20 °C. phase III: a = 3.990 Å, b = 5.669 Å, c = 5.682 Å at −10 °C. phase IV: a = 4.001 Å, α = 89°51' at −168 °C.	47Miy, 51Rho, 57Shi, 57Jon
b	Crystal structure: phase I: Z = 1 [a]), Table 1A-10-002. phase II: Z = 1 [a]), Tables 1A-10-003, 1A-10-004, 1A-10-005; X-ray profile analysis. phase III: Z = 2 [b]), Table 1A-10-006; Fig. 1A-10-006, Fig. 1A-10-007. phase IV: Z = 1 [c]), Tables 1A-10-007, 1A-10-008, 1A-10-009.	[a]) 46Meg 80Tan, 78Gla [b]) 57Shi [c]) 74Hew
4a	Thermal expansion: Figs. 1A-10-008, 1A-10-009, 1A-10-010; Table 1A-10-010. Lattice distortion due to p: Fig. 1A-10-011, Fig. 1A-10-012. Lattice distortion due to E: Fig. 1A-10-013. Lattice distortion in regard to particle size: Fig. 1A-10-014. Lattice constant in $BaTiO_{3-x}F_x$ ($0<x<0.1$); see Lattice constant in La doped ceramics (0 to 5 at%); see	 90End 89Kle
5a	Bulk crystal: Dielectric constant vs. T : Figs. 1A-10-015...1A-10-019. C = 1.5(1)·10^5 K, Θ_p =115 °C. Dielectric dispersion: 1) 10^{-3}...10^3 Hz; the dispersion was attributed to the surface layer with the thickness smaller than 10^{-2} cm. 2) 10^2...10^{10} Hz; Figs.1A-10-020...1A-10-023; see also: 3) far infrared to visible region; Figs. 1A-10-024...1A-10-028. 4) ultraviolet region; Fig. 1A-10-029. Effect of hydrostatic pressures p on κ: Figs. 1A-10-030...1A-10-033. Phase diagram in regard to p: Figs. 1A-10-034...1A-10-037. Phase diagram in regard to two-dimensional pressures: Fig. 1A-10-038. Phase diagram in regard to E_{bias}: Fig. 1A-10-039. p–T–E_{bias} phase diagram; see Effect of additives: Fig. 1A-10-040. Ceramics: Dielectric constant vs. T : Figs. 1A-10-041...1A-10-46. C = 10.48·10^4 K in the wide T range of $\Theta_f < T <$ 400 °C. κ' and $\tan\delta$ of ceramics prepared from titanate oxides (anatase and rutile); see Dielectric dispersion: Fig. 1A-10-047, Fig. 1A-10-048. Size effects (density, grain size, thickness): Figs.1A-10-049...1A-10-054; see also Aging effect of ac electric field on κ' and $\tan\delta$: Fig. 1A-10-055, Fig. 1A-10-056; see also Effects of additives: Table 1A-10-011; Al;	 85Neu 89Flo 91Fes, 91Fer 76Kin, 85Ari 92WuK1 80Taw 87Aru

	Mn; Fig.1A-10-057, see also	78Per1
	Co;	90Arm, 78Mol
	Zr;	83Iss
	Ce;	91Pan1
	La;	92Emo
	$BaTiO_3$–Ni composite ceramics;	91Sar
	$BaTiO_3$–$LiFe_5O_8$ composite ceramics;	
	Thin film:	
	Dielectric constant vs. T: Figs. 1A-10-058...1A-10-061.	
	Dielectric dispersion: Fig. 1A-10-062.	
b	Nonlinear dielectric properties: Figs. 1A-10-063...1A-10-065; see also	85Neu
	Effect of E_{bias} on κ: Fig. 1A-10-066.	
c	Spontaneous polarization: Figs. 1A-10-067...1A-10-069.	
	Coercive field: Fig. 1A-10-070.	
	Grain size effect on spontaneous polarization and coercive field in ceramics: Figs.1A-10-071...1A-10-074.	
	Thin film: film thickness 220 nm, substrate Si single crystal, deposition temperature 650 °C;	
	$P_r = 15.9 \cdot 10^{-2}$ Cm^{-2}, $E_c = 10.2 \cdot 10^5$ Vm^{-1}; see	93Des
d	Electrocaloric effect: Fig. 1A-10-075.	
	Pyroelectricity: Fig. 1A-10-076, Fig. 1A-10-077.	
6a	Heat capacity: Figs. 1A-10-078...1A-10-080; see also	73Str
	Transition heat, transition entropy: Table 1A-10-012.	
b	Thermal conductivity: Figs. 1A-10-081...1A-10-083; see also	71Man
7a	Piezoelectricity: Tables 1A-10-013...1A-10-016;	
	Fig. 1A-10-084, Fig. 1A-10-085; see also	59Hui, 50Cas
b	Electrostriction: Fig. 1A-10-086, Fig. 1A-10-087.	
8a	Elastic compliances and stiffnesses: Tables 1A-10-015...1A-10-017; see also Table 1A-10-014; for single crystal: see Figs. 1A-10-088...1A-10-093; for ceramics: see Figs. 1A-10-094...1A-10-096.	
b	Nonlinear elastic properties: Fig. 1A-10-097, Fig. 1A-10-098.	
9a	Refractive indices:	
	Tables 1A-10-018...1A-10-021; Figs. 1A-10-099...1A-10-103.	
	Birefringence:	
	Tables 1A-10-018, 1A-10-021; Figs. 1A-10-104...1A-10-107.	
	Reflection and absorption:	
	1) far-infrared region: Figs. 1A-10-108...1A-10-111.	
	2) infrared region: Fig. 1A-10-112.	
	IR absorption due to OH bands: Fig. 1A-10-113.	
	IR absorption due of Nb doped single crystals.	81Mor
	IR absorption due of La or Yb doped ceramics.	90Nas
	IR power spectra with different particle shapes.	89Dia

	3) visible region: Fig. 1A-10-114, Fig. 1A-10-115. with additives: Figs. 1A-10-116...1A-10-120. 4) ultraviolet region: Figs. 1A-10-121...1A-10-126; see also Table 1A-10-022. Effects of pressure on the absorption edge: see	59Suc
b	Effects of E_{bias} on the absorption edge: Figs. 1A-10-127...1A-10-129. Linear electrooptic effect: Fig. 1A-10-130, Fig. 1A-10-131; Tables 1A-10-023...1A-10-025. Electrooptic constants for different λ: see $r_{\lambda i}$ for different values of ac electric fields: see $r_{\lambda i}$ of reduced and oxidized crystals: see r_{42} in the temperature range of 18.5...19.5 °C : see Quadratic electrooptic effect: Figs. 1A-10-132...1A-10-135.	67Zhe 89Jul 90Jul 92Abd
c	Piezooptic effect: Fig. 1A-10-136; Table 1A-10-025.	
d	Faraday rotation: Fig. 1A-10-137; Table 1A-10-026.	
e	Optical SHG susceptibilities: Fig. 1A-10-138, Fig. 1A-10-139; $\left\|d_{15}/d_{36}^{KDP}\right\| = 35(3),\ d_{31}/\left\|d_{36}^{KDP}\right\| = -37(3),\ d_{33}/\left\|d_{36}^{KDP}\right\| = -14(1)$ at RT, for $\lambda =$ 1.0582 μm; see For absolute signs, see Two photon absorption coefficient: Fig. 1A-10-140; see also	63Mil 70Mil 90Bog
10a	Raman scattering: Figs. 1A-10-141...1A-10-147; Table 1A-10-027; for scattering of the central-peak: Fig. 1A-10-148; for reduced and doped ceramics: Figs. 1A-10-149...1A-10-151; for powder with size of 10 nm...1 μm: see Hyper-Raman scattering: Fig. 1A-10-152. Polariton: Figs. 1A-10-153...1A-10-156. Time-resolved spectroscopy of the soft modes: Fig. 1A-10-157.	94Sch
b	Brillouin scattering: Fig. 1A-10-158. Rayleigh scattering: Fig. 1A-10-159; see also	78Loo
11	Electrical conductivity σ of $BaTiO_3$ depends on various factors such as method of synthesis, crystal state (single or polycrystal), ferroelectric domain configuration, material used as electrode, aging, etc.: information concerning such factors may be obtained; see Conductivity of as-grown crystals and ceramics: Figs. 1A-10-160...1A-10-164. Conductivity associated with doping or reduction: Figs. 1A-10-165...1A-10-174. There appears a temperature range near the Curie point where $d\rho/dT > 0$ (ρ: resistivity) in doped or reduced ceramics. Recent articles on the semiconductor ceramics with positive temperature coefficient of ρ: see	69Gur 88AlA1, 89Che, 94Gil1, 88AlA2, 91Pan2, 88AlA3, 89Sin
	σ vs. oxygen pressure p_{O2}: Fig. 1A-10-175, Fig. 1A-10-176; see also	76Dan1, 76Hen, 93Osa

	Effect of cation ratio Ba/Ti (0.99...1.01) on σ: see	89Rad
	Effect of hydrostatic pressure on σ: Fig. 1A-10-177; see also	69Wem
	Piezoresistivity: see	63Mat
	Relationship between σ and absorption coefficient: Fig. 1A-10-178.	
	Hall mobility: Fig. 1A-10-179, Fig. 1A-10-180; see also	76Ibr, 74Gru, 69Wem
	Drift mobility: see	79Boy
	Seebeck effect: Fig. 1A-10-181, Fig. 1A-10-182; see also	78Ihr
	Effective mass: $m^* = 6.5(2) \cdot m_0$ in n-type crystals; see also	67Ber, 79Boy, 69Wem
	Breakdown field: Fig. 1A-10-183, Fig. 1A-10-184; see also	89Shi, 84Dak, 75Sch, 64Ued, 64Kaw
	Positron annihilation spectra: Fig. 1A-10-185.	
	X-ray and ultraviolet photoelectron spectra: Fig. 1A-10-186, Fig. 1A-10-187; Table 1A-10-028.	
	Photoconductivity and photoemission: Figs. 1A-10-188...1A-10-190; see also	90Mah
	Luminescence: Figs. 1A-10-191...1A-10-193; see also	86Kos
	Band structure: Fig. 1A10−194; see also	67Bre, 91Cas, 92Coh, 94XuY
	Ba is essentially a fully Ba^{2+} ion, while Ti 3d states hybridize with O 2p states: see	92Coh
12	Effect of intense magnetic field on Θ_f: Fig. 1A-10-195; the effect is very small; $\Delta\Theta_f \approx 0.2...0.3$ K at 200 kOe; see also	81Wag, 84Ism, 82Fle
	Effect of intense magnetic field on κ: Fig. 1A-10-196.	
13a	NMR: Fig. 1A-10-197, Fig. 1A-10-198.	
b	ESR spin Hamiltonian parameters: Table 1A-10-029, Table 1A-−10−030; Figs. 1A-10-199...1A-10-204.	
	ESR linewidth vs. T: Fig. 1A-10-205, Fig. 1A-10-206.	
	ESR study for light-sensitive centers: see	92Sch, 92Pos, 94Pos, 94War
	ESR study in semiconducting ceramics: see	85Kut
c	Mössbauer effect: Figs. 1A-10-207...1A-10-211; see also	80Wid, 85Her
14a	Bragg reflections due to structural modulation: Fig. 1A-10-212, Fig. 1A-10-213;	
b	Diffuse electron scattering: see	64Hon, 66Har

	Diffuse X-ray scattering: Fig. 1A-10-214; see also	67Har1, 68Com1, 68Com2, 70Com, 71Com
	Inelastic neutron scattering: for cubic phase: Figs. 1A-10-215...1A-10-222; for tetragonal phase: Figs. 1A-10-223...1A-10-225.	
15a	Domain structure: Figs. 1A-10-226...1A-10-228. Domains have been observed by various methods.	
	1) Polarized light: see	48Mat, 49For, 84Bor
	2) Etching method: Fig. 1A-10-229; see also	55Hoo
	Etchant for revealing domain structure; hydrochloric acid or hydrofluoric acid; see	59Pea, 86HuY
	3) Powder pattern technique: see	59Pea
	4) Decoration technique: see	66Saw
	5) X-ray topography: see	64Nii, 65Cas, 81Kaw, 64Lam
	6) Transmission electron microscope: see	64Tan, 66Rem, 67Rem, 86HuY
	7) Scanning electron microscope: see	72LeB, 83Ari
	8) Photoemission microscope: see	70Mor, 70LeB
	9) Acoustic microscope: see	85Koj
	10) Electron-mirror microscope: see	70Som
	11) Nematic liquid crystal: see	93Bie1
	12) Interferometric study of 90° domains: see	61Bhi, 63Bhi
	Domain boundary has been studied by several methods.	
	1) Transmission electron microscope: see	76Mal, 92Tsa1, 92Shi
	2) Reflection electron microscope: see	92Tsa2
	3) Electron holographic study: see	94Zha2, 93Zha
	(111) twin boundary was studied by high-resolution transmission electron microscopy and electron-energy-loss spectroscopy: see	94Rec
	Domain structure in crystals grown from high-temperature solution: see	94Par1, 94Par2
	Variation of domain structure with temperature change: see	85Beu, 93Bie1
	Formation of domain structure at P–F phase transition: see	78Sur, 86Gav, 84Bur, 86Bur

	Influence of illumination on the domain structure: see	72Fri, 94Cud
	Electro luminescence and light emission associated with domain switching: see	80Gon, 81Fle
	Domain structure of ceramics was observed by etching method: Fig.1A-10-230; and by transmission electron microscope; see	89Kas
	Domain structure of thin film: see	72Yak, 94Tsa
	Domain structure of fine crystal and powder: see	93Hsi, 94Boc
b	Domain wall motion was studied by following methods.	
	1) Optical method: see	54Mer, 60Sav
	2) Successive-etching method: see	63Sta, 64Sta
	3) X-ray topography: see	79Tak
	4) Transmission electron microscope: see	70Sha
	The domain shapes in motion depend on the applied field and temperature: see	64Sta, 84Lee
	The wall velocity is proportional to $\exp(-\delta/E)$ at relatively low field. δ is an activation field for domain wall motion: Figs. 1A-10-231...1A-10-237.	
	Effect of elastic stress on domain structure: see	90Bor
	Influence of polishing on the domain structure: see	88Beu
16	Surface:	
	The first suggestion about the existence of surface layers of $BaTiO_3$ crystal was made by Känzig [a]) on the basis of electron diffraction studies of very small particles of $BaTiO_3$ [b]).	[a]) 55Kan [b]) 54Ani
	Structure of surface layers have been studied by following diffraction methods.	
	1) Electron diffraction in thin single crystals [c]): the thickness of the layer was estimated to be very thin.	[c]) 64Tan
	2) LEED experiment [d]): several superlattice structures were observed on the (100) surface in a wide range of temperature from RT up to 1000 °C.	[d]) 71Abe1, 71Abe2
	3) Electron mirror microscope [e]): estimated thickness ≈ 0.7 μm.	[e]) 68Eng
	The dependence of the following quantities on the thickness of the crystal has been observed as evidence of the existence of surface layers.	
	1) Switching time: see	56Mer, 59Dro
	2) Optical absorption coefficient: estimated thickness ≈ 6 μm; see	60Cou
	3) Dielectric dispersion: see	61Sch
	4) Permittivity: estimated thickness ≈ 12 μm; see	62Cou
	Several anomalies due to existence of surface space charge layer have been observed under externally applied field.	
	1) Electroluminescence (rf electric field): estimated thickness; ≈ 0.35 μm; see	58Har
	2) Electron emission: see	93Bie2
	3) Birefringence: see	60Tri
	4) Domain wall velocity: see	65Cal, 71Deg
	5) Pyroelectricity: estimated thickness ≈ 0.1 μm; see	56Chy2
	6) Resistivity change: see	68Buc

7) X-ray diffraction: estimated thickness ≈ 1.5 μm; see	72Mot, 78Dud2
8) Theoretical discussion about surface layers: see	59Jan, 59Dvo
Anomalous mean square atomic displacement, thermal expansion and Grüneisen constant by LEED for (001) surface: see	81Lub
Anomalous surface charge layer by double Laue pattern topography using synchrotron X-ray radiation: see	84Bor
Radiation damage: Fig. 1A-10-238, Fig. 1A-10-239; see also	66Hau, 57Wit
Photorefractive effect:	
1) Decay rate: see	83Val, 84Duc
2) Effect of Fe doping: see	86God
3) Amplitude and phase of the photorefractive field: see	91Law
4) Intensity dependent absorption and photorefractive phenomena: see	88Bro, 87Mot, 90Bro, 90Tem, 91Tem
5) Intensity dependent photogalvanic effect: see	92Cud
6) Performance of 45°-cut crystal: see	89For, 92Zhu
7) Self-pumped phase-conjugation: see	85Gun, 87Eas, 88Gow, 94Yan

Table 1A-10-001. $BaTiO_3$. Solubility in KF solution [54Kar].

T [°C]	1000	1050	1100	1150	1200	1250	1300
$BaTiO_3$ [mol %]	4	6	9	12.5	17	22.5	28.5

Table 1A-10-002. $BaTiO_3$. Fractional coordinates of atoms in the unit cell of phase I [52Meg].

	x	*y*	*z*
Ba	0	0	0
Ti	1/2	1/2	1/2
O	1/2	1/2	0
	1/2	0	1/2
	0	1/2	1/2

Table 1A-10-003. $BaTiO_3$. Fractional coordinates of atoms in the unit cell of phase II [70Har, 71Fra]. See also [78Gla].

	x	y	z	Δ_z *)	Δ_z **)	β_{33} *)	β_{33} **)	β_{11} *)	β_{11} **)	β_{22} *)	β_{22} **)
						[Å^2]					
Ba	0	0	0			0.32(7)	0.34(4)	0.51(6)	0.53(6)		
Ti	1/2	1/2	1/2+Δ_z(Ti)	0.0135(4)	0.0135	0.32(2)	0.33(4)	0.30(2)	0.27(6)		
O(1)	1/2	1/2	Δ_z[O(1)]	–0.024(1)	–0.0250(4)	0.32	0.32(3)	0.57	0.57(6)		
O(2)	1/2	0	1/2+Δ_z[O(2)]	–0.0150(9)	–0.0150(3)	0.32	0.33(3)	0.67	0.67(1)	0.56	0.56(1)
O′(2)	0	1/2	1/2+Δ_z[O(2)]								

*) X-ray diffraction data. **) Neutron diffraction data.

Table 1A-10-004. $BaTiO_3$. Interatomic distances in phase II [70Har].

Bond lengths	[Å]	Atomic shifts	[Å]
Ti–O(1)	2.1720	Δ_z(Ti)	0.0544
Ti–O(2)	2.0300	Δ_z[O(1)]	0.1008
Ba–O(1)	2.8425	Δ_z[O(2)]	0.0617
Ba–O(2)	2.7948		

Table 1A-10-005. $BaTiO_3$. Fractional coordinates of atoms in the unit cell of phase II [88Jia].

	x	*y*	*z*	*B* [Å^2]
Ba	0.000	0.000	0.000	4.5(1)
Ti	0.500	0.500	0.515(5)	5.2(3)
O(1)	0.521(6)	0.521(6)	–0.031(3)	4.1(3)
O(2)	0.000	0.500	0.481(3)	4.4(1)

Table 1A-10-006. $BaTiO_3$. Fractional coordinates of atoms in the unit cell of phase III [57Shi].

	x	*y*	*z*
Ba	0	0	0
	0	1/2	1/2
Ti	1/2	0	$1/2+\Delta z_{Ti}$
	1/2	1/2	Δz_{Ti}
O(1)	0	0	$1/2+\Delta z_{O(1)}$
	0	1/2	$\Delta z_{O(1)}$
	1/2	$1/4+\Delta y_{O(2)}$	$1/4+\Delta z_{O(2)}$
O(2)	1/2	$3/4+\Delta y_{O(2)}$	$3/4+\Delta z_{O(2)}$
	1/2	$3/4-\Delta y_{O(2)}$	$1/4+\Delta z_{O(2)}$
	1/2	$1/4-\Delta y_{O(2)}$	$3/4+\Delta z_{O(2)}$

$\Delta z_{Ti} = +0.010$; $\Delta z_{O(1)} = -0.010$;
$\Delta z_{O(2)} = -0.013$; $\Delta y_{O(2)} = +0.003$.

Table 1A-10-007. $BaTiO_3$. Fractional coordinates of atoms in the unit cell of phase IV [74Hew]. Neutron powder profile analysis; lattice parameters a, b, c, α, β, γ and scattering lengths b_{Ba}, b_{Ti}, b_O were also refined in the analysis.

	x	y	z
Ba	Δ_z(Ba)	Δ_z(Ba)	Δ_z(Ba)
Ti	1/2+Δ_z(Ti)	1/2+Δ_z(Ti)	1/2+Δ_z(Ti)
O(1)	1/2+Δ_z(O)	1/2+Δ_x(O)	Δ_z(O)
O(2)	1/2+Δ_z(O)	Δ_z(O)	1/2+Δ_x(O)
O(3)	Δ_z(O)	1/2+Δ_x(O)	1/2+Δ_x(O)

Δ_z(Ba) = 0.013(3)
Δ_z(Ti) = 0
Δ_x(O) = 0.024(2)
Δ_z(O) = 0.031(2)
B(Ba) = 0.26(8) Å^2
B(Ti) = 0.10(15) Å^2
B(O) = 0.24(3) Å^2

$a = b = c$ = 4.001 Å
$\alpha = \beta = \gamma$ = 89.868(4)°
b_{Ba} = 0.517(7) · 10^{-12} cm
b_{Ti} = 0.347(6) · 10^{-12} cm
b_O = 0.58 · 10^{-12}cm

Table 1A-10-008. $BaTiO_3$. Atomic displacement in three phases [74Hew]. Δ(M):displacement of M atom relative to the fixed center of mass, where M stands for Ba, Ti or O. ||, ⊥: parallel and perpendicular to the ferroelectric axis [hkl].

	tetr [001] 20 °C [70Har]	orth [001] –10 °C [57Shi]	rh [111] 77.4 K [74Hew]	
$\Delta_{\parallel}$(Ba)	0.004	0.002	0.001(21)	[Å]
$\Delta_{\parallel}$(Ti)	0.058(2)	0.059	0.091	[Å]
$\Delta_{\parallel}(O_I)$	–0.093(4)	–0.055	–0.091(14)	[Å]
$\Delta_{\parallel}(O_{II})$	–0.057(4)	–0.072	–0.091	[Å]
$\Delta_{\parallel}(O_{III})$	–0.057	–0.072	–0.091	[Å]
$\Delta_{\perp}(O_I)$	0	0.017	0.023	[Å]

Table 1A-10-009. $BaTiO_3$. Fractional coordinates of atoms in the unit cell of phase IV [81Sch]. a_{rh} = 4.004(3) Å, α_{rh} = 89.87°, not refined. β_{ij} [Å^2]: defined by Eq.(c) of Introduction.

Ba	0	0	0
β_{11}(Ba)	0.0025(2)		$\rightarrow$ B = 0.162(12) Å^2
β_{12}(Ba)	0.0004(2)		
Ti	1/2–x_{Ti}	1/2–x_{Ti}	1/2–x_{Ti}
x_{Ti}	0.0111(3)		
β_{11}(Ti)	0.0017(2)		
β_{12}(Ti)	0.0006(2)		$\rightarrow$ B = 0.112(12) Å^2
O	1/2+x_O	1/2+x_O	z_O
x_O	0.0110(2)		
z_O	0.0180(2)		
β_{11}(O)	0.0044(1)		
β_{33}(O)	0.0036(1)		$\rightarrow$ B = 0.266(6) Å^2
β_{12}(O)	–0.0003(1)		
β_{13}(O)	–0.0003(1)		

Table 1A-10-010. $BaTiO_3$. Unit cell parameters vs. T [81She].

Temperature interval [°C]	Crystal symmetry	Analytical expressions for thermal behaviour [Å]
–170 to –68.9	rhombohedral	$a = 4.00758 + 0.1881 \cdot 10^{-4}\ T$
–98.5 to 8.2	monoclinic	$a = 4.01566 - 0.2569 \cdot 10^{-4}\ T$ $c = 3.99021 + 0.1069 \cdot 10^{-3}\ T$
–5.9 to 121.4	tetragonal	$a = 3.99153 + 0.6284 \cdot 10^{-4}\ T$ $- 0.3443 \cdot 10^{-7}\ T^2 + 0.3495 \cdot 10^{-8}\ T^3$ $c = 4.03641 - 0.8647 \cdot 10^{-4}\ T$ $+ 0.9716 \cdot 10^{-6}\ T^2 - 0.9753 \cdot 10^{-8}\ T^3$
118.6 to 220	cubic	$a = 4.00692 + 0.1537 \cdot 10^{-4}\ T$ $+ 0.8277 \cdot 10^{-7}\ T^2$

Table 1A-10-011. $BaTiO_3$ with additives. Parameters of the dielectric dispersion in the Cole-Cole formula, $\kappa = \kappa_\infty + \Delta\kappa / \{1 + (i f / f_r)\}^{1-\alpha}$ [92Kaz]. f_r: the relaxation frequency.

	$BaTi_{1-x}Zr_xO_3$		$BaTi_{1-x}Hf_xO_3$		$Ba_{1-y}Sr_yTiO_3$		
	x = 0.1	x = 0.2	x = 0.1	x = 0.2	y = 0.1	y = 0.2	y = 0.3
f_r [MHz]	300	90	350	80	450	730	450
$\Delta\kappa$	1280	11.10^3	4800	26.10^3	1100	1730	3360
κ_∞	480	2.10^3	520	5.10^3	610	100	960
α	0.19	0.28	0.27	0.05	0.01	0.05	0.01

	$Ba_{1-y}Ca_yTiO_3$		$Ba_{1-y}Pb_yTiO_3$			$BaTi_{1-z}Li_zO_{3-3z}F_{3z}$		
	y = 0.05	y = 0.1	y = 0.05	y = 0.1	y = 0.2	z = 0.025	z = 0.05	z = 0.01
f_r [MHz]	700	$>10^3$	700	800	$>10^3$	100	150	500
$\Delta\kappa$	1440	–	460	320	–	7900	3900	1630
κ_∞	520	–	490	270	–	900	1400	330
α	0.02	–	0.01	0.01	–	0.15	0.05	0.21

Table 1A-10-012. $BaTiO_3$. Transition heat and transition entropy.

Transition	ΔQ_m [J mol^{-1}]	ΔS_m [J mol^{-1}K^{-1}]	Ref.
IV→III	33.5(84)	0.17	52Shi
	59.8	0.29	52Vol
	50	0.25	52Tod
III→II	92(17)	0.318	52Shi
	64.8	0.226	52Vol
	67	0.242	52Tod
II→I	209(21)	0.523	52Shi
	196	0.50	52Vol
	196	0.50	48Bla

Table 1A-10-013. $BaTiO_3$ (single crystal and ceramics). Piezoelectric constants and electromechanical coupling factor [66Bec].

	d_{15}	d_{31}	d_{33}	g_{15}	g_{31}	g_{33}	k_{15}	k_{31}	k_{33}	k_p	T	Ref.
	$[\cdot 10^{-12}\,CN^{-1}]$			$[\cdot 10^{-3}\,m^2C^{-1}]$							[°C]	
single crystal		–57.7	132								20	50Cas
	392	–34.5	85.6	15.3	–23.1	57.6	0.570	0.315	0.560		25	58Ber
		–33.3										59Hui
		–103.3	316.6								RT	51Bon
ceramic	270	–79	191	18.8	–4.7	11.4	0.476	0.208	0.493	0.378	25	56Bec
	260	–78	190	20.2	–5.2	12.6	0.48	0.212	0.50	0.36	25	64Ber

	e_{15}	e_{31}	e_{33}	h_{15}	h_{31}	h_{33}	T	Ref.
	$[Cm^{-2}]$			$[\cdot 10^8\,NC^{-1}]$			[°C]	
ceramic	11.6	–4.4	18.6	10.3	–3.5	14.8	25	56Bec
	11.4	–4.35	17.5	11.5	–3.9	15.6	25	64Ber

Table 1A-10-014. $BaTiO_3$ (ceramics, plain and modified, commercial). Dielectric, piezoelectric, electromechanical and elastic constants (at 25 °C, except for $Ca_{0.12}Pb_{0.08}Ba_{0.80}TiO_3$) [66Bec].

Composition	κ_{33}^{T}	d_{15}	d_{31}	d_{33}	g_{15}	g_{31}	g_{33}	s_{11}^{E}	s_{12}^{E}	s_{66}
		$[\cdot 10^{-12}\,CN^{-1}]$			$[\cdot 10^{-3}\,m^2C^{-1}]$			$[\cdot 10^{-12}\,m^2N^{-1}]$		
$BaTiO_3$	1350 ...1700		–56	130 ...160				8.47	–2.38	21.7
$Ca_{0.05}Ba_{0.95}TiO_3$ (ceramics B) [a])	1200	242	–58	149	21.0	–5.5	14.1	8.6	–2.6	22.4
$Pb_{0.05}Ba_{0.95}TiO_3$	1180		–53	129				9.09	–2.64	23.64
$Ca_{0.06}Pb_{0.04}Ba_{0.90}TiO_3$	800		–40	115				8.06	–2.34	20.8
$Ca_{0.08}Pb_{0.12}Ba_{0.80}TiO_3$	450		–20	60		–5.0	15.0	7.8	–2.3	20.2
$Ca_{0.12}Pb_{0.08}Ba_{0.80}TiO_3$	600		–35	90		–7.3	18	13		

Composition	k_{15}	k_{31}	k_{33}	k_p	κ_{11}^{T}	κ_{11}^{S}	κ_{33}^{S}	e_{15}	e_{31}	e_{33}
								$[Cm^{-2}]$		
$Ca_{0.05}Ba_{0.95}TiO_3$ (ceramics B) [a])	0.48	0.194	0.48	0.33	1300	1000	910	10.9	–3.1	13.5
$Ca_{0.08}Pb_{0.12}Ba_{0.80}TiO_3$	0.30	0.113	0.34	0.19			395			
$Ca_{0.12}Pb_{0.08}Ba_{0.80}TiO_3$		0.12	0.30	0.22						

Composition	s_{11}^{D}	s_{33}^{E}	s_{33}^{D}	s_{12}^{D}	s_{13}^{E}	s_{13}^{D}	s_{44}^{E}	s_{44}^{D}	h_{15}	h_{31}	h_{33}
	$[\cdot 10^{-12}\,m^2N^{-1}]$								$[\cdot 10^{8}\,NC^{-1}]$		
$Ca_{0.05}Ba_{0.95}TiO_3$ (ceramics B) [a])	8.3	9.1	7.0	–2.9	–2.7	–1.9	22.2	17.1	12.3	–3.8	16.7
$Ca_{0.08}Pb_{0.12}Ba_{0.80}TiO_3$	7.7	8.1	7.15	–2.4							

Composition	c_{11}^{E}	c_{11}^{D}	c_{33}^{E}	c_{33}^{D}	c_{12}^{E}	c_{12}^{D}	c_{13}^{E}	c_{13}^{D}	c_{44}^{E}	c_{44}^{D}	c_{66}
	$[\cdot 10^{9}\,Nm^{-2}]$										
$Ca_{0.05}Ba_{0.95}TiO_3$ (ceramics B) [a])	158	159	150	177	69	70	67.5	62	45	58.5	45

[a]) Trade Mark: Clevite Corporation, Cleveland, Ohio, USA.

Table 1A-10-015. $BaTiO_3$. Elastic and piezoelectric constants at 25 °C and 130 °C [86Sch].

T [°C]	25 [a])	25	130
κ_{33}	168.0	130.0	1783.00
κ_{11}	1970.00	4000.00	1960.00
s_{11}^{E} [$\cdot 10^{-12}$ m^2N^{-1}]	8.05	7.35	10.40
s_{33}^{E}	15.70	14.95	36.25
s_{12}^{E}	–2.35	–1.39	1.15
s_{13}^{E}	–5.24	–4.94	–11.62
s_{55}^{E}	18.40	18.21	14.85
s_{66}	8.84	8.33	9.61
s_{11}^{D}	7.25	6.24	5.49
s_{33}^{D}	10.80	10.00	9.55
s_{12}^{D}	–3.15	–2.60	–2.40
s_{13}^{D} [$\cdot 10^{-12}$ m^2N^{-1}]	–3.26	–3.00	–0.14
s_{55}^{D}	12.40	7.36	9.59
d_{31} [$\cdot 10^{-12}$ CN^{-1}]	–34.50	–33.40	–284.00
d_{33}	85.60	68.50	695.00
d_{15}	392.00	647.00	338.00
g_{31} [$\cdot 10^{-2}$ VmN^{-1}]	–2.30	–3.00	–1.70
g_{33}	5.75	5.61	4.10
g_{15}	1.52	1.74	1.75
k_{31}	0.315	0.39	0.69
k_{33}	0.56	0.55	0.87
k_{15}	0.57	0.75	0.60

[a]) [58Ber].

Table 1A-10-016. $BaTiO_3$. Elastic and piezoelectric constants at 23 °C [94Zgo].

Parameter	Value	Parameter	Value	Parameter	Value
$\kappa_{11}^{\mathbf{T}}$	4400(400)	$c_{11}^{\boldsymbol{D}}$ [$\cdot 10^9$ Nm^{-2}]	223(10)	$s_{11}^{\boldsymbol{E}}$ [$\cdot 10^{-12}$ N^{-1}m^2]	7.4(3)
$\kappa_{33}^{\mathbf{T}}$	129(5)	$c_{12}^{\boldsymbol{D}}$	109(5)	$s_{33}^{\boldsymbol{E}}$	13.1(1.5)
$\kappa_{11}^{\mathbf{S}}$	2200(200)	$c_{13}^{\boldsymbol{D}}$	102(5)	$s_{12}^{\boldsymbol{E}}$	–1.483)
$\kappa_{33}^{\mathbf{S}}$	56(3)	$c_{33}^{\boldsymbol{D}}$	240(10)	$s_{13}^{\boldsymbol{E}}$	–4.4(5)
d_{31} [$\cdot 10^{-12}$ CN^{-1}]	–33.4(20)	$c_{55}^{\boldsymbol{D}}$	121(5)	s_{66}	7.6(8)
d_{33}	90(5)	$c_{11}^{\boldsymbol{E}}$	222(10)	$s_{55}^{\boldsymbol{E}}$	16.4(16)
d_{15}	564(40)	$c_{12}^{\boldsymbol{E}}$	108(18)	$s_{11}^{\boldsymbol{D}}$	6.4(3)
e_{31} [Cm^{-2}]	–0.7(6)	$c_{13}^{\boldsymbol{E}}$	111(8)	$s_{33}^{\boldsymbol{D}}$	5.6(10)
e_{33}	6.7(3)	$c_{33}^{\boldsymbol{E}}$	151(7)	$s_{12}^{\boldsymbol{D}}$	–2.3(4)
e_{15}	34.2(18)	$c_{55}^{\boldsymbol{E}}$	61(3)	$s_{13}^{\boldsymbol{D}}$	–1.7(3)
		c_{66}	134(6)	$s_{55}^{\boldsymbol{D}}$	8.4(16)

Table 1A-10-017. $BaTiO_3$ (single crystal and ceramics). Elastic constants [66Bec].

	s_{11}^E	s_{11}^D	s_{33}^E	s_{33}^D	s_{12}^E	s_{12}	s_{13}^E	s_{13}^D	s_{44}^E	s_{44}^D	s_{66}	T	Ref.
	[$\cdot 10^{-12}$ m^2N^{-1}]											[°C]	
Single crystal	9.26											25	50Cas
	11.2											RT	51Bon
	8.05	7.25	15.7	10.8	–2.35	–3.15	–5.24	–3.26	18.4	12.4	8.84	25	58Ber
Ceramics	8.55	8.18	8.93	6.76	–2.61	–2.98	–2.85	–1.95	23.3	18.3	22.3	25	56Bec
	9.1	8.7	9.5	7.1	–2.7	–3.0	–2.9	–1.9	22.8	17.5	23.6	25	64Ber
	c_{11}^E	c_{11}^D	c_{33}^E	c_{33}^D	c_{12}^E	c_{12}^D	c_{13}^E	c_{13}^D	c_{44}^E	c_{44}^D	c_{66}	T	Ref.
	[$\cdot 10^9$ Nm^{-2}]											[°C]	
Single crystal	275.1	282.6	164.9	178.1	179.0	186.5	151.6	141.6	54.34	80.64	113.1	25	66Bec, 58Ber
		206				140				126		RT	51Bon
Ceramics	166	168	162	189	76.6	78.2	77.5	71.0	42.9	54.6	44.8	25	56Bec
	150	150	146	171	66	68	66	57	44	57	43	25	64Ber
	165.6			180.7					42.48	53.02	45.65	25	55Hun

Table 1A-10-018. $BaTiO_3$. Refractive indices and birefringence [93Bus]. T = 20 °C.

λ [nm]	n_e	n_o	$n_e - n_o$
488	2.447	2.520	–0.073
514	2.424	2.491	–0.067
532	2.410	2.474	–0.064
633	2.360	2.412	–0.052

Table 1A-10-019. $BaTiO_3$. Parameters of the Sellmeier equation [93Bus]. n_e, n_o: extraordinary and ordinary refractive indices. A, B, C: parameters in the equation of $n^2(\lambda) - 1 = A + \{B\lambda^2/(\lambda^2 - C)\}$.

T	n_e			n_o		
[°C]	A	B	C [$\cdot 10^{-14}$ m^2]	A	B	C [10^{-14} m^2]
20	2.109	2.022	7.095	2.154	2.141	7.890
30	1.898	2.239	6.647	2.139	2.166	7.777
40	1.458	2.661	5.800	1.527	2.739	6.581
50	1.770	2.364	6.333	1.881	2.399	7.175
60	1.649	2.482	6.380	1.711	2.550	7.125
70	1.668	2.472	6.460	1.578	2.677	6.909
80	1.846	2.314	6.798	1.658	2.601	7.021

Table 1A-10-020. $BaTiO_3$. Thermooptic coefficient dn_e/dT for wavelength λ and temperature T [93Bus]. n_e: extraordinary refractive index.

T	dn_e/dT [$\cdot 10^{-5}$ K^{-1}]			
[°C]	λ = 488 nm	λ = 514 nm	λ = 532 nm	λ = 633 nm
20	26	25	23	18
40	28	25	23	19
60	37	34	33	30
80	56	51	49	41

Table 1A-10-021. $BaTiO_3$ (Fe doped). Refractive indices [86God]. λ = 632.8 nm. T = RT.

Iron concentration	"pure"	0.075%	0.125%
n_c	2.4060	2.4381	2.4100
n_a	2.4875	2.5277	2.4900
$\lvert n_c - n_a \rvert$	0.0815	0.0896	0.0800

Table 1A-10-022. $BaTiO_3$, $SrTiO_3$, TiO_2. Energies of fundamental absorption edges [in eV] at RT [65Car].

	E_0	A_1	A_2	A_3	B_1	B_2	C_1	C_2	D	E	
$SrTiO_3$	3.2	4.00	4.86	5.5	6.52	7.4	9.2	9.9	12.5	15.3	[eV]
$BaTiO_3$	3.2	3.91	4.85		6.10	7.25	10.3	11.8	12.8	15	[eV]
TiO_2 ($E \perp c$)		3.97	5.52		6.50	7.64	8.53	9.24	11	14.1	[eV]

Table 1A-10-023. $BaTiO_3$. Electrooptic constants [69Bec].

	r_{13}	r_{33}	r_{42}	$r_c = r_{33} - (n_a/n_c)^3 r_{13}$	T	λ	Ref.
	$[\cdot 10^{-12}\,mV^{-1}]$				[°C]	[nm]	
T			1640	108	25	546.1	65Joh2
S	8	28(5)		19		633	65Kam, 66Kam
S			820(100)	23(2)	25	546.1	65Joh3

Table 1A-10-024. $BaTiO_3$ (Fe doped). Electrooptic constant at constant strain [86God]. λ = 632.8 nm.

Iron concentration	pure	0.045%	0.075%	0.125%	0.250%
r_{13} [$\cdot 10^{-12}$ mV^{-1}]	11	24	96	60	126
r_{33} [$\cdot 10^{-12}$ mV^{-1}]	31	90	87	120	118
r_{42} [$\cdot 10^{-12}$ mV^{-1}]	1000	2900	7530	3700	5180

Table 1A-10-025. $BaTiO_3$. Piezooptic $p_{\lambda\mu}$ and electrooptic $r_{\lambda i}$ constants at 23 °C [94Zgo]. λ = 633 nm. n_a = 2.412, n_c = 2.360.

$p_{11}^{\boldsymbol{E}}$	$p_{12}^{\boldsymbol{E}}$	$p_{13}^{\boldsymbol{E}}$	$p_{31}^{\boldsymbol{E}}$	$p_{33}^{\boldsymbol{E}}$	$p_{55}^{\boldsymbol{E}}$
0.50(4)	0.106(19)	0.200(14)	0.070(7)	0.77(4)	1.0(2)
$r_{13}^{\mathbf{S}}$	$r_{33}^{\mathbf{S}}$	$r_{42}^{\mathbf{S}}$	$r_{13}^{\mathbf{T}}$	$r_{33}^{\mathbf{T}}$	$r_{42}^{\mathbf{T}}$
$[\cdot 10^{-12}\,\mathrm{mV^{-1}}]$					
10.2(6)	40.6(25)	730(100)	8(2)	105(10)	1300(100)

Table 1A-10-026. $BaTiO_3$, $SrTiO_3$, $KTaO_3$, $KTa_{0.35}Nb_{0.65}O_3$ (KTN), TiO_2. Band gap energies $\hbar\omega_g$ [in eV] [67Bae]. F_1, F_2: different dispersion functions $F_1(\omega/\omega_g)$. See Fig. 1A-10-137.

	$SrTiO_3$		$BaTiO_3$	$KTaO_3$		KTN	TiO_2	
	296 K	77 K	403 K	296 K	77 K	296 K	296 K	
Faraday rotation $\hbar\omega_g$ for F_1	3.40	3.43	3.25	3.77	3.79	3.54	3.62	eV
Faraday rotation $\hbar\omega_g$ for F_2	3.21	3.26	3.11	3.62	3.65	3.36	3.37	eV
Energy of reflectivity peak or shoulder	3.20	–	3.20	–	–	3.70	–	eV
Energy of electro-reflectance singularity	–	–	3.20	3.57	–	3.60	3.00	eV
				3.80			3.30	eV
$\hbar\omega_g$ from absorption data	3.40	–	–	3.75	–	–	–	eV
Energy at which absorption coefficient $\alpha \approx 10^4$ [cm^{-1}]	3.37	–	3.26	3.79	–	3.45	3.18	eV

Table 1A-10-027. $BaTiO_3$. Optical-branch vibration mode assigned at 25 °C [68DiD]. The crystal was produced by the top-seeded solution technique.

Cubic re-	Raman scattering data [$\cdot 10^2$ m^{-1}]; accuracy ± $3 \cdot 10^2$ m^{-1}							
presentation	E(TO, *xy*)	E(TO, *z*)	E(LO, *xy*)	A_1(TO, *xy*)	A_1(LO, *z*)	E(TO+LO, *xy*)	E(TO+LO, *z*)	B_1
F_{1u}	36	36	715	≈180	727	–	–	–
F_{1u}	180	180	180	80	178	–	–	–
F_{1u}	486	518	463	470	470	–	–	–
F_{2u}	–	–	–	–	–	305	305	305

Table 1A-10-028. $BaTiO_3$. X-ray photoelectron spectroscopic determination of core level binding energies to the O 1s level taken at 531.0 eV [78Per2].

Level	Binding energy [eV]
O 1s	531.00
Ti $2p_{1/2}$	465.6(1)
Ti $2p_{3/2}$	459.8(1)
Ba $4d_{3/2}$	92.5(1)
Ba $4d_{5/2}$	89.8(1)

Level	Binding energy [eV]
Ti $3p_{1/2}$, Ti $3p_{3/2}$	38.6(1)
Ba 5s	30.5(1)
O 2s	23.0(1)
Ba $5p_{1/2}$	16.7(1)
Ba $5p_{3/2}$	14.9(1)

Table 1A-10-029. $BaTiO_3$. Summary of ESR parameters for various paramagnetic centers in doped $BaTiO_3$.

*)	Site	S	**H**	ν [GHz]	T [K]	g–factor	FS: D, E, a, F, b [$\cdot 10^{-2}$ m^{-1}]	HFS: I	A, B [$\cdot 10^{-2}$ m^{-1}]	Ref.
Mn^{2+}	Ti^{4+}	5/2	(7)	9.3	78	2.0016(5)	D=56(5)	5/2	$^{55}A_{\parallel}$=$^{55}A_{\perp}$ [a]) $^{55}A_{\parallel}$=79.8(5)	60Ism
					300	2.0023(5)	D=65(5)		$^{55}A_{\parallel}$=78.6(5) [b])	63Ode
					440	2.0009(1)	a=14(5)		$^{55}A_{\parallel}$=79(5) [c])	64Iku
	Ba^{2+}	5/2	(7)	9.3	RT	2.002(1)	D=+215(2) E=0 a=+16.76(94)		$^{55}A_{\parallel}$=–77.4(6) $^{55}A_{\perp}$=–82.3(8)	
					438	2.002(1)	D=0 E=0 a=+12.11(94)		$^{55}A_{\parallel}$=$^{55}A_{\perp}$ $^{55}A_{\parallel}$=–79.3(4)	66Iku [1]) [2])
Fe^{3+}	Ti^{4+}	5/2	(7)	5...7.5, 10,16.3	393, 433	2.003	D=0 a=102(12)		[d])	59Hor, 62Rim
				10	300	2.0036(2)	D=+929 E=0 a=+91(20)		[e])	63Sak [2])
					276	2.0036(2)	D=–530(10) a=+105(20)		[f])	
					213	2.0036(2)	D=–640(10), E=0.0(13)			
					77	2.0036(2)	D=0 E=0 a=+115(10)			
					173	2.003(2)	D=–23(5) a–F=+113(10)			64Sak [2]) [3])
Co^{2+}	Ti^{4+}	1/2	(3)	9	4	4.347 (isotropic)		7/3	$^{59}A_{\parallel}$=$^{59}A_{\perp}$ $^{59}A_{\parallel}$=109	67Zda
							b_{20} b_{40} b_{60}			
Gd^{3+}	Ba^{2+}	7/2	(8)	12,18	300	1.995(3)	–293.6(10) +4.0(10) 1.6(10)			62Rim
					425	1.995(3)	– ≈6 –			
	Ti^{4+}			10	RT	1.992	– 24.0(9) –3.7(28)			64Tak
					436	1.992	23.3(4) –1.8(4)			66Tak1
Pt^{3+}	Ti^{4+}	1/2	(3)	10	4	$g_{\|\|}$=1.950(5), $g_{\perp}$=2.459(3)		1/2	^{195}A= 0(5) ^{195}B=135(5)	66Sim
					78	$g_{\|\|}$=1.935(5), $g_{\perp}$=2.51(2)			^{195}A<28 ^{195}B=135(10)	63Sro1
e^-	**)	1/2	(2)	10	55	1.930	1.911		[g])	63Sro2, 66Tak2, 67Tak

*) Paramagnetic center. **) Oxygen vacancy.

[a]) Temperature dependence of D^2 in the tetragonal phase is linear [65Ves].

[b]) Forbidden transition lines (ΔM=±1, Δm=±1) are observed. [63Ode, 64Iku].
Forbidden transition lines (ΔM=±1, Δm=±2) are observed. [65Iku, 66Iku].

[c]) Temperature dependence of ^{55}A. [67Zda2].

[d]) Fe^{3+} spectra are studied with a d.c. bias electric field near transition temperature from cubic to tetragonal phase and from tetragonal to orthorhombic phase. [63Sak2, 64Ell].

[e]) Forbidden transition lines (ΔM=2, 3, 4, 5) are observed in the rhombohedral phase. [64Sak].

[f]) Fe^{3+} spectra due to the oxygen vacancy; $g_{||} \cong 2$, $g_{\perp}$=6.0(1) at 77 K. [65Gai].

[g]) Hyperfine structure of an electron captured by an oxygen vacancy. [64Dan].

[1]) Mn^{2+} ion takes the place of Ti^{4+} lattice site in ceramics, while it takes the place of Ba^{2+} in a single crystal.

[2]) Positive a is assumed.

[3]) Fe^{3+} spectra in a single-domain specimen.

Table 1A-10-030. $BaTiO_3 : Gd^{3+}$. Spin Hamiltonian parameters of Gd^{3+} substituting for Ba^{2+} ions in $BaTiO_3$ measured at GHz range [68Tak].

T [°C]	g-factor (isotropic)	FS $[10^{-2}\,m^{-1}]$	
152	1.992(3)		$b_{40} \approx$ 6
27	1.992(3)	$b_{20} =$ –293.6(10)	$b_{40} =$ 4.0(10)
			$b_{44} =$ –2.0(10)
–23	1.993(3)	$b_{20} =$ 267.3(10)	$b_{40} =$ 2.8(10)
		$b_{22} =$ 5.6(20)	$b_{42} =$ 11.2(30)
			$b_{44} =$ –10.2(30)
–196	1.992	$b_{20} =$ 340	$b_{40} =$ 2

References

42Wai Wainer, E., Salomon, A.N.: Titanium Alloy Manufacturing Company, Electr. Rep. **8** (1942); cited in: von Hippel, A: Rev. Mod. Phys. **22** (1950) 221.
44Oga Ogawa, T.: Presented at the Meeting of the Research Institute of High Dielectric Constant Materials (1944); cited in: Ogawa, T.: Busseiron Kenkyu No. 6 (1947) 1.
44von von Hippel, A., et al.: N. D. R. C. Rep. No. 300 (August, 1944); cited in: von Hippel, A: Rev. Mod. Phys. **22** (1950) 221.
45Meg Megaw, H.D.: Nature **155** (1945) 484.
45Wul Wul, B.: Nature **156** (1945) 480.
46Meg Megaw, H.D.: Proc. Phys. Soc. (London) **58** (1946) 133.
46von von Hippel, A., Breckenridge, R.G., Chesley, F.G., Tisza, L.: Ind. Eng. Chem. **38** (1946) 1097.
46Wul1 Wul, B.: Nature **157** (1946) 808.
46Wul2 Wul, B., Goldman, L.M.: C. R. Acad. Sci. USSR **51** (1946) 21.
47Meg Megaw, H.D.: Proc. R. Soc. (London) A **189** (1947) 261.
47Miy Miyake, S., Ueda, R.: J. Phys. Soc. Jpn. **2** (1947) 93.
48Bla Blattner, H., Merz, W.: Helv. Phys. Acta **21** (1948) 210.
48Bur Burbank, R.D., Evans Jr., H.T.: Acta Crystallogr. **1** (1948) 330.
48Eva Evans Jr., H.T., Burbank, R.D.: J. Chem. Phys. **16** (1948) 634.
48Mat Matthias, B., von Hippel, A.: Phys. Rev. **73** (1948) 1378.
49For Forsbergh Jr., P.W.: Phys. Rev. **76** (1949) 1187.
49Kay Kay, H.E., Vousden, P.: Philos. Mag. [7] **40** (1949) 1019.
49Mer Merz, W.J.: Phys. Rev. **76** (1949) 1221.
49Rho Rhodes, R.G.: Acta Crystallogr. **2** (1949) 417.
50Cas Caspari, M.E., Merz, W.I.: Phys. Rev. **80** (1950) 1082.
51Bon Bond, W.L., Mason, W.P., Mc Skimin, H.J.: Phys. Rev. **82** (1951) 442.
51Rho Rhodes, R.G.: Acta Crystallogr. **4** (1951) 105.
52Meg Megaw, H.D.: Acta Crystallogr. **5** (1952) 739.
52Shi Shirane, G., Takeda, A.: J. Phys. Soc. Jpn. **7** (1952) 1.
52Tod Todd, S.S., Lorenson, R.E.: J. Am. Chem. Soc. **74** (1952) 2043.
52Vol Volger, J.: Philips Res. Rep. **7** (1952) 21.
53Mer Merz, W.J.: Phys. Rev. **91** (1953) 513.
54Ani Aniiker, M., Brugger, H.R., Känzig, W.: Helv. Phys. Acta **27** (1954) 99.
54For Forsberg Jr., P.W.: Phys. Rev. **93** (1954) 686.
54Kar Karan, C.: J. Chem. Phys. **22** (1954) 957.
54Mer Merz, W.J.: Phys. Rev. **95** (1954) 690.
54Rem Remeika, J.P.: J. Am. Chem. Soc. **76** (1954) 940.
55Cam Campell, D.S.: Philos. Mag. [7] **46** (1955) 1261.
55Hoo Hooton, A.J., Merz, W.J.: Phys. Rev. **98** (1955) 409.
55Hue Hueter, T.F., Neuhaus, D.P.: J. Acoust. Soc. Am. **27** (1955) 292.
55Hun Huntington, H.B., Southwick, R.D.: J. Acoust. Soc. Am. **27** (1955) 677.
55Kan Känzig, W.: Phys. Rev. **98** (1955) 549.
55Ras Rase, D.E., Roy, R.: J. Am. Ceram. Soc. **38** (1955) 102.
55Wie1 Wieder, H.H.: Phys. Rev. **99** (1955) 1161.
55Wie2 Wieder, H.H.: J. Appl. Phys. **26** (1955) 1479.
56Bec Bechmann, R: J. Acoust. Soc. Am. **28** (1956) 347.
56Chy1 Chynoweth, A.G.: J. App. Phys. **27** (1956) 78.
56Chy2 Chynoweth, A.G.: Phys. Rev. **102** (1956) 705.
56Mer Merz, W.J.: J. Appl. Phys. **27** (1956) 938.
56Rog Rogers Jr., F.T.: J. Appl. Phys. **27** (1956) 1066.

57Har Harman, G.G.: Phys. Rev. **106** (1957) 1358.
57Jon Jona, F., Pepinsky, R.: Phys. Rev. **105** (1957) 861.
57Mar Marutake, M., Ikeda, T.: J. Phys. Soc. Jpn. **12** (1957) 233.
57Sch Schmitt, H.J.: Z. Angew. Phys. **9** (1957) 107.
57Shi Shirane, G., Danner, H., Pepinsky, R.: Phys. Rev. **105** (1957) 856.
57Tak Takeda, A.: Bull. Kobayashi Inst. Phys. Res. **7** (1957) 59.
57Wit Wittels, M.C., Sherrill, F.A.: J. Appl. Phys. **28** (1957) 606.
58Ben Benedict, T.S., Durand, J.L.: Phys. Rev. **109** (1958) 1091.
58Ber Berlincourt, D., Jaffe, H.: Phys. Rev. **111** (1958) 143.
58Har Harman, G.G.: Phys. Rev. **111** (1958) 27.
58Ike Ikeda, T.: J. Phys. Soc. Jpn. **13** (1958) 809.
58Inu Inuishi, Y., Uematsu, S.: J. Phys. Soc. Jpn. **13** (1958) 761.
58Mey Meyerhofer, D.: Phys. Rev. **112** (1958) 413.
58Pul Pulvari, C.F., Kuebler, W.: J. Appl. Phys. **29** (1958) 1315.
59Cas Casella, R.C., Keller, S.P.: Phys. Rev. **116** (1959) 1464.
59DeV DeVries, R.C.: J. Am. Ceram. Soc. **42** (1959) 547.
59Dro Drougard, M.E., Landauer, R.: J. Appl. Phys. **30** (1959) 1663.
59Dvo Dvorak, V.: Czech. J. Phys. **9** (1959) 710.
59Hor Hornig, A.W., Rempel, R.C., Weaver, H.E.: J. Phys. Chem. Solids **10** (1959) 1.
59Hui Huibregtse, E.J., Bessey, W.H., Drougard, M.E.: J. Appl. Phys. **30** (1959) 899.
59Jan Janovec, V.: Czech. J. Phys. **9** (1959) 468.
59Mil Miller, R.C., Savage, A.: Phys. Rev. **115** (1959) 1176.
59Pea Pearson, G.L., Feldman, W.L.: J. Phys. Chem. Solids **9** (1959) 28.
59Sau Sauer, H.A., Flaschen, S.S., Hoesterey, D.C.: J. Am. Ceram. Soc. **42** (1959) 363.
59Suc Suchan, H.L., Balchan, A.S., Drickamer, H.G.: J. Phys. Chem. Solids **10** (1959) 343.
60Bra Branwood, A., Tredgold, R.H.: Proc. Phys. Soc. (London) **76** (1960) 93.
60Cou Coufova, P., Arend, H.: Czech. J. Phys. B **10** (1960) 663.
60Gla Glaister, R.M., Kay, H.F.: Proc. Phys. Soc. (London) **76** (1960) 763.
60Gur Gurevich, V.M., Rez, I.S.: Fiz. Tverd. Tela **2** (1960) 673; Sov. Phys. Solid State (English Transl.) **2** (1960) 624.
60Ism Ismailzade, I.G.: Izv. Akad. Nauk SSSR, Ser. Fiz. **24** (1960) 1198; Bull. Acad. Sci. USSR, Phys. Ser. (English Transl.) **24** (1960) 1201.
60Sav Savage, A., Miller, R.C.: J. Appl. Phys. **31** (1960) 1546.
60Tri Triebwasser, S.: Phys. Rev. **118** (1960) 100.
61Bhi Bhide, V.G., Bapat, N.J.: Physica (Amsterdam) **27** (1961) 531.
61Hey Heywang, W.: Solid State Electron. **3** (1961) 51.
61Kar Karchevskii, A.I.: Fiz. Tverd. Tela **3** (1961) 3092; Sov. Phys. Solid State (English Transl.) **3** (1962) 2249.
61Sch Schlosser, H., Drougard, M.F.: J. Appl. Phys. **32** (1961) 1227.
62Bra Branwood, A., Hughes, O.H., Hurd, J.D., Tredgold, R.H.: Proc. Phys. Soc. (London) **79** (1962) 1161.
62Cou Coufova, P., Arend, H.: Czech. J. Phys. B **12** (1962) 308.
62Hil Hilczer, B.: Phys. Status Solidi **2** (1962) 447.
62Ike Ikegami, S., Ueda, I., Kisaka, S., Mitsuishi, A., Yoshinaga, H.: J. Phys. Soc. Jpn. **17** (1962) 1210.
62Kab Kabalkina, S.A., Vereshchagin, L.F., Shulenin, B.M.: Dokl. Akad. Nauk SSSR **144** (1962) 1019; Sov. Phys. Dokl. (English Transl.) **7** (1962) 527.
62Mak Makishima, S., Hasegawa, K., Shionoya, S.: J. Phys. Chem. Solids **23** (1962) 749.
62Pop Poplavko, Yu.M.: Fiz. Tverd. Tela **4** (1962) 1069; Sov. Phys. Solid State (English Transl.) **4** (1962) 787.
62Rim Rimai, L., deMars, G.A.: Phys. Rev. **127** (1962) 702.
62Spi Spitzer, W.G., Miller, R.C., Kleinman, D.A., Howarth, L.F.: Phys. Rev. **126** (1962) 1710.

63Bhi Bhide, V.G., Bapat, N.J.: J. Appl. Phys. **34** (1963) 181.
63Cox Cox, G.A., Tredgold, R.H.: Phys. Lett. **4** (1963) 199.
63Mat Mattes, B.L.: J. Appl. Phys. **34** (1963) 682.
63Mil Miller, R.C., Kleinman, D.A., Savage, A.: Phys. Rev. Lett. **11** (1963) 146.
63Ode Odehnal, M.: Czech. J. Phys. B **13** (1963) 566.
63Sak1 Sakudo, T.: J. Phys. Soc. Jpn. **18** (1963) 1626.
63Sak2 Sakudo, T., Unoki, H., Maekawa, S.: J. Phys. Soc. Jpn. **18** (1963) 913.
63Sro1 Sroubek, Z., Zd'ansky, K., Simanek, E.: Phys. Status Solidi **3** (1963) K1.
63Sro2 Sroubek, Z., Zd'ansky, K.: Czech. J. Phys. B **13** (1963) 309.
63Sta Stadler, H.L., Zachmanidis, P.J.: J. Appl. Phys. **34** (1963) 3255.
64Bal Ballantyne, J.M.: Phys. Rev. **136** (1964) A429.
64Ber Berlincourt, D.A., Curran, D.R., Jaffe, H.: Piezoelectric and Piezomagnetic Materials and Their Function in Transducers, in Physical Acoustics, Vol. 1, Part A, Mason, W.P. (ed.), New York: Academic Press, 1964, p. 169.
64Bro Brown, F., Taylor, C.E.: J. Appl. Phys. **35** (1964) 2554.
64Dan Danilyuk, Yu.L., Kharitonov, F.V.: Fiz. Tverd. Tela **6** (1964) 322; Sov. Phys. Solid State (English Transl.) **6** (1964) 260.
64Ell Elliott, W.R., Bjorkstam, J.L.: J. Phys. Chem. Solids **25** (1964) 1273.
64Hon Honjo, G., Kodera, S., Kitamura, N.: J. Phys. Soc. Jpn. **19** (1964) 351.
64Ike Ikegami, S., Ueda, I.: J. Phys. Soc. Jpn. **19** (1964) 159.
64Iku Ikushima, H., Hayakawa, S.: J. Phys. Soc. Jpn. **19** (1964) 1986.
64Kaw Kawabe, K., Uematsu, S., Inuishi, Y.: J. Inst. Electr. Eng. Jpn. **84** (1964) 1414.
64Lam Lambert, M., Quittet, A.M., Taupin, C., Guinier, A.: J. Phys. (Paris) **25** (1964) 345.
64Law Lawless, W.N., DeVries, R.C.: J. Appl. Phys. **35** (1964) 2638.
64Mil Miller, R.C.: Phys. Rev. **134** (1964) A1313.
64Mot Motegi, H., Mitsui, T.: J. Phys. Chem. Solids **25** (1964) 253.
64Nii Niizeki, N., Hasegawa, M.: J. Phys. Soc. Jpn. **19** (1964) 550.
64Pop Poplavko, Yu.M.: Fiz. Tverd. Tela **6** (1964) 58; Sov. Phys. Solid State (English Transl.) **6** (1964) 45.
64Sak Sakudo, T., Unoki, H.: J. Phys. Soc. Jpn. **19** (1964) 2109.
64Sta Stadler, H.L., Zachmanidis, P.J.: J. Appl. Phys. **35** (1964) 2895.
64Tak Takeda, T., Watanabe, A.: J. Phys. Soc. Jpn. **19** (1964) 1742.
64Tan Tanaka, M., Honjo, G.: J. Phys. Soc. Jpn. **19** (1964) 954.
64Ued Ueda, I., Takiuchi, M., Ikegami, S., Sato, H.: J. Phys. Soc. Jpn. **19** (1964) 1267.
65Bal Ballantyne, J.M.: Phys. Rev. **138** (1965) A646.
65Bhi Bhide, V.G., Multani, M.S.: Phys. Rev. **139** (1965) A1983.
65Cal Callahy, D.R.: J. Appl. Phys. **36** (1965) 2751.
65Car Cardona, M.: Phys. Rev. **140** (1965) A651.
65Cas Caslavsky, J., Polcarova, M.: Czech. J. Phys. B **15** (1965) 372.
65Gai Gainon, D.J.A.: J. Appl. Phys. **36** (1965) 2325.
65Iku Ikushima, H., Hayakawa, S.: J. Phys. Soc. Jpn. **20** (1965) 1517.
65Joh1 Johnson, C.J.: Appl. Phys. Lett. **7** (1965) 221.
65Joh2 Johnston, A.R., Weingar, J.M.: J. Opt. Soc. Am. **55** (1965) 828.
65Joh3 Johnston, A.R.: Appl. Phys. Lett. **7** (1965) 195.
65Kam Kaminow, I.P.: Appl. Phys. Lett. **7** (1965) 123; erratum: **8** (1966) 54.
65Mak Makishima, S., Yamamoto, H., Tomotsu, T., Shionoya, S.: J. Phys. Soc. Jpn. **20** (1965) 2147.
65Sas Sasaki, H.: Jpn. J. Appl. Phys. **4** (1965) 24.
65Sue Suemune, Y.: J. Phys. Soc. Jpn. **20** (1965) 174.
65Ued Ueda, I., Ikegami, S.: J. Phys. Soc. Jpn. **20** (1965) 546.
65Ves Veselc, J., Sroubek, Z., Zdansky, K.: Phys. Status Solidi **10** (1965) K99.

66Bec Bechmann, R., Hearmon, R.F.S.: Landolt-Börnstein, New Series, Group III, Vol. 1: Elastic, Piezoelectric, Piezooptic and Electrooptic Constants of Crystals, Hellwege, K.-H., Hellwege, A.M. (eds.), Berlin, Heidelberg, New York: Springer, 1966.
66Car Carlsson, L.: Acta Crystallogr. **20** (1966) 459.
66Har Harada, J., Tanaka, M., Honjo, C.: J. Phys. Soc. Jpn. **21** (1966) 968.
66Hau Hauser, O., Schenk, M.: Phys. Status Solidi **18** (1966) 543.
66Hug Hughe, O.H., Tredgold, R.H., Williams, R.H.: J. Phys. Chem. Solids **27** (1966) 79.
66Iku Ikushima, H.: J. Phys. Soc. Jpn. **21** (1966) 1866.
66Kam Kaminow, I.P.: Appl. Phys. Lett. **8** (1966) 305.
66Per Perfilova, V.E., Sonin, A.S.: Fiz. Tverd. Tela **8** (1966) 107; Sov. Phys. Solid State (English Transl.) **8** (1966) 82.
66Rem Remaut, C., Cevers, R., Lagasse, A., Amelinckx, S.: Phys. Status Solidi **13** (1966) 125.
66Sam Samara, C.A.: Phys. Rev. **151** (1966) 378.
66Saw Sawada, A., Abe, R.: Jpn. J. Appl. Phys. **5** (1966) 401.
66Sch Schenk, M.: Krist. Tech. **1** (1966) 305.
66Sim Simanek, E., Sroubek, Z., Zd'ansky, K., Kacxer, J., Novak, L.: Phys. Status Solidi **14** (1966) 333.
66Sta Stadler, H.L.: J. Appl. Phys. **37** (1966) 1947.
66Tak1 Takeda, T., Watanabe, A.: J. Phys. Soc. Jpn. **21** (1966) 1132; erratum: **21** (1966) 1628.
66Tak2 Takeda, T., Watanabe, A.: J. Phys. Soc. Jpn. **21** (1966) 267.
67Bae Baer, W.S.: J. Phys. Chem. Solids **28** (1967) 677.
67Ber Bergulund, C.N., Baer, W.S.: Phys. Rev. **157** (1967) 358.
67Bra Bradt, R.C., Ansell, C.S.: Mater. Res. Bull. **2** (1967) 585.
67Bre Brews, J.R.: Phys. Rev. Lett. **18** (1967) 662.
67Fro Frova, A., Boddy, P.J.: Phys. Rev. **153** (1967) 606.
67Gah Gahwiller, Ch.: Phys. Kondens. Mater. **6** (1967) 269.
67Har1 Harada, J., Honjo, C.: J. Phys. Soc. Jpn. **22** (1967) 45.
67Har2 Harada, J., Motegi, H., Honjo, C., Mitsui, T., Hoshino, S.: J. Phys. Soc. Jpn. **22** (1967) 1515.
67Man Mante, A.J.H., Volger, J.: Phys. Lett. A **24** (1967) 139.
67Rem Remaut, C., Cevers, R., Amelinckx, S.: Phys. Status Solidi **20** (1967) 613.
67Shi Shirane, G., Frazer, B.C., Minkiewicz, V.J., Leake, J.A., Linz, A.: Phys. Rev. Lett. **19** (1967) 234.
67Tak Takeda, T., Watanabe, A.: J. Phys. Soc. Jpn. **23** (1967) 469.
67Yam Yamamoto, H., Kakishima, S., Shionoya, S.: J. Phys. Soc. Jpn. **23** (1967) 1321.
67Zda1 Zd'ansky, K., Arend, H., Kubec, F.: Phys. Status Solidi **20** (1967) 653.
67Zda2 Zd'ansky, K.: Phys. Lett. A **24** (1967) 337.
67Zhe Zheludev, I.S., Sidnenko, E.V., Teplyakova, S.I.: Kristallografiya **12** (1967) 604; Sov. Phys. Crystallogr. (English Transl.) **12** (1968) 528.
68Buc Buchman, P.: Solid State Electron. **11** (1968) 767.
68Com1 Comes, R., Lambert, M., Guinier, A.: C. R. Acad. Sci. (Paris), Ser. B **266** (1968) 959.
68Com2 Comes, R., Lambert, M., Guinier, A.: Solid State Commun. **6** (1968) 715.
68DiD DiDomenico Jr., M., Wemple, S.H., Porto, S.P.S., Bauman, R.P.: Phys. Rev. **174** (1968) 522.
68Eng English, F.L.: J. Appl. Phys. **39** (1968) 3231.
68Rou Rousseau, D.L., Porto, S.P.S.: Phys. Rev. Lett. **20** (1968) 1354.
68Tak Takeda, T.: J. Phys. Soc. Jpn. **24** (1968) 533.
68Wem Wemple, S.H., DiDomenico Jr., M., Camlibel, I.: J. Phys. Chem. Solids **29** (1968) 1797.
69Are Arend, H., Kihlborg, L.: J. Am. Ceram. Soc. **52** (1969) 63.
69Bec Bechmann, R., Hearmon, R.F.S., Kurtz, S.K.: Landolt-Börnstein, New Series, Group III, Vol. 2: Elastic, Piezoelectric, Piezooptic, Electrooptic Constants, and Nonlinear Dielectric Susceptibilities of Crystals, Hellwege, K.-H., Hellwege, A.M. (eds.), Berlin, Heidelberg, New York: Springer, 1969.

69Gur Gurevich, V. M.: Elektroprovodnost' Segnetoelektrikov, Moskva: Izdatel'stvo Komiteta Standartov, Mer I Izmeritel'nykh Priboroy pri Sovete Ministrov SSSR, 1969; Electric Conductivity of Ferroelectrics, Jerusalem: Israel Program for Scientific Translations, 1971.
69Kud Kudxin, A.Yu., Bunina, L K., Crxhegorxhevskii, O. A.: Fiz. Tverd. Tela **11** (1969) 2397; Sov. Phys. Solid State (English Transl.) **11** (1970) 1939.
69Son Sonin, A.S., Perfilova, V.E.: Kristallografiya **14** (1969) 510; Sov. Phys. Crystallogr. (English Transl.) **14** (1969) 419.
69Wem Wemple, S.H., DiDomenico Jr., M., Jayaraman, A.: Phys. Rev. **180** (1969) 547.
69Yam Yamada, Y., Shirane, G., Linx, A.: Phys. Rev. **177** (1969) 848.
70Coh Cohen, M.G., DiDomenico Jr., M., Wemple, S.H.: Phys. Rev. B **1** (1970) 4334.
70Com Comes, R., Lambert, M., Guinier, A.: Acta Crystallogr., Sect. A **26** (1970) 244.
70Har Harada, J., Pedersen, T., Barnea, Z.: Acta Crystallogr., Sect. A **26** (1970) 336.
70LeB Le Bihan, R.: C. R. Acad. Sci. (Paris), Ser. B **270** (1970) 741.
70Mil Miller, R.C., Nordland, W.A.: Phys. Rev. B **2** (1970) 4896.
70Mor Morlon, B., Coquet, E., Devin, A.: C. R. Acad. Sci. (Paris), Ser. B **270** (1970) 283.
70Sha Shakmanov, V.V., Spivak, G.V., Yakunin, S.I.: Fiz. Tverd. Tela **12** (1970) 2286: Sov. Phys. Solid State (English Transl.) **12** (1971) 1827.
70Shi Shirane, G., Axe, J.D., Harada, J., Linx, A.: Phys. Rev. B **2** (1970) 3651.
70Som Someya, T., Azumi, T., Kobayashi, J.: J. Phys. Soc. Jpn. Suppl. **28** (1970) 374.
70Wem Wemple, S.H.: Phys. Rev. B **2** (1970) 2679.
71Abe1 Aberdam, D., Bouchet, G., Ducros, P.: Surface Sci. **27** (1971) 559.
71Abe2 Aberdam, D., Caubert, C.: Surface Sci. **27** (1971) 571.
71Bel Belruss, V., Kalnajs, J., Linx, A., Folweiler, R.C.: Mater. Res. Bull. **6** (1971) 899.
71Bur Bursian, F.V., Girshberg, Ya.G., Starov, F.N.: Phys. Status Solidi (b) **46** (1971) 529.
71Com Comes, R., Denoyer, F., Lambert, M.: J. Phys. (Paris) **32**, Suppl. C-5a (1971) 195.
71Deg Deguchi, K., Nakamura, E.: J. Phys. Soc. Jpn. **30** (1971) 301.
71Fra Fraxer, B.C.: Structural Phase Transitions and Soft Modes, Proceedings of the NATO Advanced Study Institute, held at Geilo, 1971, p. 43.
71Har Harada, J., Axe, J.D., Shirane, G.: Phys. Rev. B **4** (1971) 155.
71Joh Johnston, A.R.: J. Appl. Phys. **42** (1971) 3501.
71Kud Kudxin, A.Yu., Kashchenko, E.P., Kostrub, V.I.: Fiz. Tverd. Tela **13** (1971) 3733; Sov. Phys. Solid State (English Transl.) **13** (1972) 3162.
71Lax Laxay, P.D., Fleury, P.A.: Proceedings of the Second International Conference on Light Scattering in Solids, Balkanski, M. (ed.), held in Paris (1971), Paris: Flammarion Sciences, 1971, p. 406.
71Man Mante, A.J.H., Volger, J.: Physica **52** (1971) 577.
71Sam Samara, G.A.: Ferroelectrics **2** (1971) 277.
72Bhi Bhide, V.G., Durge, V.V.: Solid State Commun. **10** (1972) 401.
72Fon Fontana, M.P., Lambert, M.: Solid State Commun. **10** (1972) 1.
72Fri Fridkin, V.M., Grekov, A.A., Kosonogov, N.A., Volk, T.R.: Ferroelectrics **4** (1972) 169.
72LeB Le Bihan, R., Maussion, M.: C. R. Acad. Sci. (Paris), Ser. B **273** (1972) 1075.
72Mag Maguire, H.G., Rees, L.V.C.: J. Phys. (Paris) **33**, Suppl. C-2 (1972) 173.
72Mot Motegi, H.: J. Phys. Soc. Jpn. **32** (1972) 202.
72Tie Tien, T.Y., Garretson, R.M.: J. Cryst. Growth **16** (1972) 177.
72Yak Yakunin, S.I., Shakmanov, V.V., Spivak, G.V., Vasil'eva, N.V.: Fiz. Tverd. Tela **14** (1972) 373: Sov. Phys. Solid State (English Transl.) **14** (1972) 310.
73Kas Kashida, S., Hatta, I., Ikushima, A., Yamada, Y.: J. Phys. Soc. Jpn. **34** (1973) 997.
73Mic Michel-Calendini, F.M., Mesnard, G.: J. Phys. C **6** (1973) 1709.
73Mur Murakami, T., Miyashita, T., Nakahara, M., Sekine, E.: J. Am. Ceram. Soc. **56** (1973) 294.
73Sha Shapkin, V.V., Gromov, B.A., Petrov, G.T., Cirshberg, Ya.G., Bursian, F.V.: Fiz. Tverd. Tela **15** (1973) 1401; Sov. Phys. Solid State (English Transl.) **15** (1973) 947.

73Str Strukov, B.A., Ivanov-Shits, A.K.: Kristallografiya **18** (1973) 866; Sov. Phys. Crystallogr. (English Transl.) **18** (1974) 548.
73Sue Sueoka, O.: Phys. Lett. A **43** (1973) 459.
74Gru Grushevskii, Yu.A., Cirshberg, Ya.G., Bursian, E.V.: Fiz. Tverd. Tela **16** (1974) 248; Sov. Phys. Solid State (English Transl.) **16** (1974) 161.
74Hei Heiman, D., Ushida, D.: Phys. Rev. B **9** (1974) 2122.
74Hew Hewat, A.W.: Ferroelectrics **6** (1974) 215.
75Sch Schomann, K.D.: Appl. Phys. **6** (1975) 89.
76Dan1 Daniels, J.: Philips Res. Rep. **31** (1976) 505.
76Dan2 Daniels, J., Hardtl, K.H.: Philips Res. Rep. **31** (1976) 489.
76Hat Hatta, I., Ikushima, A.: J. Phys. Soc. Jpn. **41** (1976) 558.
76Hen Hennings, D.: Philips Res. Rep. **31** (1976) 516.
76Hol Holste, J.C., Lawless, W.N., Samara, G.A.: Ferroelectrics **11** (1976) 337.
76Ibr Ibrig, H.: J. Phys. C **9** (1976) 3469.
76Kin Kinoshita, K., Yamaji, A.: J. Appl. Phys. **47** (1976) 371.
76Mal Malis, T., Gleiter, H.: J. Appl. Phys. **47** (1976) 5195.
77Cla Clarke, R., Benguigui, L.: J. Phys. C **10** (1977) 1963.
77Fel Feltz, A., Langbein, H.: Ferroelectrics **15** (1977) 7.
77Law Lawless, W.N., Morrow, A.J.: Ferroelectrics **15** (1977) 167.
77Sca Scalabrin, A., Chaves, A.S., Shim, D.S., Porto, S.P.S.: Phys. Status Solidi (b) **79** (1977) 731.
77Toy Toyoda, M., Ishida, M., Hirose, Y.: Mem. Fac. Eng., Kobe Univ. **23** (1977) 189.
78Bau Bauerle, D., Braun, W., Saile, V., Sprussel, G., Koch, E.E.: Z. Phys. B **29** (1978) 179.
78Dud1 Dudler, R., Albers, J., Muser, H.E.: Ferroelectrics **21** (1978) 381.
78Dud2 Dudkevich, V.P., Zakharchenko, I.N., Fesenko, E.G.: Ferroelectrics **18** (1978) 185.
78Gla Glazer, A.M., Hidaka, M., Bordas, J.: J. Appl. Crystallogr. **11** (1978) 165.
78Ihr Ihrig, H., Hennings, D.: Phys. Rev. B **17** (1978) 4593.
78Law Lawless, W.N.: Phys. Rev. B **17** (1978) 1458.
78Loo Loose, P., Betzler, K., Baucrle, D., Kapphan, S.: Proceedings of the International Conference on Lattice Dynamics, Balkanski, M. (ed.), held in Paris (1977), Paris: Flammarion Sciences, 1978, p. 681.
78Mol Molokhia, N.M., Issa, M.A.: Pramana **11** (1978) 289.
78Per1 Peraza, J., Tello, M.J., Bocanegra, E.H., Manas-Diaz, J.: Solid State Commun. **26** (1978) 127.
78Per2 Pertosa, P., Michel-Calendini, F.M.: Phys. Rev. B **17** (1978) 2011.
78Sur Surowiak, Z., Skulski, R., Gavrilyachenko, V.G., Semenchev, A.F., Fesenko, E.G.: Fiz. Tverd. Tela **20** (1978) 2445; Sov. Phys. Solid State (English Transl.) **20** (1978) 1411.
78Tur Turik, A.V., Shevchenko, N.B.: Kristallografiya **23** (1978) 861; Sov. Phys. Crystallogr. (English Transl.) **23** (1978) 486.
79Ara Arabidze, A.A., Chikvaidze, B.Ya.: Fiz. Tverd. Tela **21** (1979) 1243; Sov. Phys. Solid State (English Transl.) **21** (1979) 722.
79Bou Bouillot, J., Escribe, C., Fitzgerald, W.J., Gnininvi, L.: Solid State Commun. **30** (1979) 521.
79Boy Boyeaux, J.P., Michel-Calendini, F.M.: J. Phys. C **12** (1979) 545.
79McC McClure, D.J., Crowe, J.R.: J. Vacuum Sci. Technol. **16** (1979) 311.
79Pan Panitz, J.K.G., Hu, C.-C.: J. Vacuum Sci. Technol. **16** (1979) 315.
79Sur Surowiak, Z.: Czech. J. Phys. **B29** (1979) 203.
79Tak Takagi, M., Akaba, N., Suzuki, S.: J. Phys. Soc. Jpn. **46** (1979) 1811.
79Tur Turik, A.V., Shevchenko, N.B.: Phys. Status Solidi (b) **95** (1979) 585.
80Agu Aguilar, M., Gonzalo, C., Godefroy, G.: Ferroelectrics **25** (1980) 467.
80Arl Arlt, G., Sasko, P.: J. Appl. Phys. **51** (1980) 4956.
80Bei Beige, H.: Acta Phys. Slov. **30** (1980) 71.
80Gon Gonzalo, C., Aguilar, M., Jaque, F., Montoto, L., Godefroy, G.: Ferroelectrics **25** (1980) 511.
80Lop Loposzko, M., Surowiak, Z., Opilski, A.: Thin Solid Films **67** (1980) 253.

80Lus Luspin, Y., Servoin, J.L., Gervais, F.: J. Phys. C **13** (1980) 3761.
80Pan Panitz, J.K.G., Hu, C.-C.: Ferroelectrics **27** (1980) 161.
80Shi Shimazu, M., Tsukioka, M., Nukui, A.: Mineral. Mag. **10** (1980) 143.
80Sur Surowiak, Z.: Ferroelectrics **23** (1980) 1.
80Tan Tanaka, M., Fujishita, H., Shiozaki, Y., Sawaguchi, E.: Jpn. J. Appl. Phys. **19** (1980) 1757.
80Taw Tawfik, A., Molkhia, N., Yousef, B.: Indian Ceram. **23** (1980) 3.
80Toc Tochitskii, E.I., Romanova, N.I.: Kristallografiya **25** (1980) 1030; Sov. Phys. Crystallogr. (English Transl.) **25** (1980) 590.
80Tom Tomashpolsky, Yu.Ya., Sevostianov, M.A.: Ferroelectrics **29** (1980) 87.
80Wid Widner, W., Gonser, U., Schmidt, H., Albers, J., Date, S.K.: Ferroelectrics **23** (1980) 193.
80Yam Yamashita, K., Koumoto, K., Takata, M., Yanagida, H.: Jpn. J. Appl. Phys. **19** (1980) 867.
81Buk Bukhan'ko, F.N., Bratashevskii, Yu.A.: Fiz. Tverd. Tela **23** (1981) 803; Sov. Phys. Solid State (English Transl.) **23** (1981) 456.
81Bur Burns, G., Dacol, F.H.: Ferroelectrics **37** (1981) 661.
81Dam Damm, A., Schmitt, H., Muser, H.E.: Appl. Phys. **25** (1981) 195.
81Dud1 Dudkevich, V.P., Bukreev, V.A., Mukhortov, Vl.M., Golovko, Yu.I., Sidneev, Yu.G., Mukhortov, V.M., Fesenko, E.G.: Phys. Status Solidi (a) **65** (1981) 463.
81Dud2 Dudkevich, V.P., Mukhortov, Vl.M., Golovko, Yu.I., Bukreev, V.A., Mukhortov, V.M., Sindeev, Yu.G., Fesenko, E.G.: Fiz. Tverd. Tela **23** (1981) 612; Sov. Phys. Solid State (English Transl.) **23** (1981) 347.
81Fis Fischer, R., Tillmanns, E.: Z. Kristallogr. **157** (1981) 69.
81Fle Flerova, S.A., Samchenko, Yu.I., Gorbenko, V.M.: Fiz. Tverd. Tela **23** (1981) 2775; Sov. Phys. Solid State (English Transl.) **23** (1981) 1624.
81God Godefroy, G., Chatry, P., Benguigui, L.: Ferroelectrics **34** (1981) 169.
81Kaw Kawata, H., Suzuki, S., Takagi, M.: J. Phys. Soc. Jpn. **50** (1981) 3398.
81Lib Liberts, G.V., Fritsberg, V.Ya.: Phys. Status Solidi (a) **67** (1981) K81.
81Lub Lubnin, E.N., Tomashpol'skii, Yu.Ya.: Fiz. Tverd. Tela **23** (1981) 3707; Sov. Phys. Solid State (English Transl.) **23** (1981) 2157.
81Mor Moretti, P., Godefroy, G., Bilbault, J.M.: Ferroelectrics **37** (1981) 721.
81Nag Nagatomo, T., Kosaka, T., Omori, S., Omoto, O.: Ferroelectrics **37** (1981) 681.
81Ols Olson, J.C., Stevison, D.F., Bransky, I.: Ferroelectrics **37** (1981) 685.
81Sch Schildkamp, W., Fischer, K.: Z. Kristallogr. **155** (1981) 217.
81Sev Sevost'yanov, M.A., Kubasov, V.I., Lubnin, E.N., Ugai, Ya.A., Tomashpol'skii, Yu.Ya.: Izv. Akad. Nauk SSSR, Neorg. Mater. **17** (1981) 2223; Inorg. Mater. (English Transl.) **17** (1981) 1661.
81She Shebanov, L.A.: Phys. Status Solidi (a) **65** (1981) 321.
81Wag Wagner, D., Bauerle, D.: Phys. Lett. A **83** (1981) 347.
81Yan Yanovskaya, M.I., Turova, N.Ya., Turevskaya, E.P., Novoselova, A.V., Venevtsev, Yu.N., Sagitov, S.I., Soboleba, E.M.: Izv. Akad. Nauk SSSR, Neorg. Mater. **17** (1981) 307; Inorg. Mater. (English Transl.) **17** (1981) 221.
82Bur Burns, G., Dacol, F.H.: Solid State Commun. **42** (1982) 9.
82Dha Dharmadhikari, V.S., Grannemann, W.W.: J. Appl. Phys. **53** (1982) 8988.
82Fle Flerova, S.A., Bochkov, O.E., Tsinman, I.L.: Fiz. Tverd. Tela **24** (1982) 2505; Sov. Phys. Solid State (English Transl.) **24** (1982) 1424.
82Vog Vogt, H., Sanjurjo, J.A., Rossbroich, G.: Phys. Rev. B **26** (1982) 5904.
83Ari Aristov, V.V., Kokhanchik, L.S., Meyer, K., Blumtritt, H.: Phys. Status Solidi (a) **78** (1983) 229.
83Dha Dharmadhikari, V.S., Grannemann, W.W.: J. Vacuum Sci. Technol. **A1** (1983) 483.
83Ino Inoue, K., Akimoto, S.: Solid State Commun. **46** (1983) 441.
83Iss Issa, M.A.A., Molokhia, N.M., Dughaish, Z.H.: J. Phys. D **16** (1983) 1109.
83Mic Michel-Calendini, F.M., Moretti, P., Godefroy, G.: Ferroelectr. Lett. **44** (1983) 257.
83Pre Presting, H., Sanjurjo, J.A., Vogt, H.: Phys. Rev. B **28** (1983) 6097.

83Toc Tochitsky, E.I., Romanova, N.I.: Thin Solid Films **110** (1983) 55.
83Val Valley, G.C., Klein, M.B.: Optical Eng. **22** (1983) 704.
84Bir Biryukov, S.V., Mukhortov, V.M., Margolin, A.M., Golovko, Yu.I., Zakharchenko, I.N., Dudkevich, V.P., Fesenko, E.G.: Ferroelectrics **56** (1984) 115.
84Bor Borodina, V.A., Kuznetsov, V.G.: Izv. Akad. Nauk SSSR, Ser. Fiz. **48** (1984) 1146; Bull. Acad. Sci. USSR, Phys. Ser. (English Transl.) **48** (1984) 103.
84Bur Bursill, L.A., Peng, J.L.: Nature **311** (1984) 550.
84Dak Dakhiya, M.S., Zakrevskii, V.A., Slutsker, A.I.: Fiz. Tverd. Tela **26** (1984) 2716; Sov. Phys. Solid State (English Transl.) **26** (1984)1645.
84Duc Ducharme, S., Feinberg, J.: J. Appl. Phys. **56** (1984) 839.
84Ism Ismailzade, I.H., Ismailov, R.M., Alekberov, A.I., Ayubova, N.A., Mehdiyeva, R.Z.: Ferroelectrics **61** (1984) 1.
84Jan Jannot, B., Escribe-Filippini, C., Bouillot, J.: J. Phys. C **17** (1984) 1329.
84Lee Lee, J.-H., Nakamura, T., Takashige, M.: Jpn. J. Appl. Phys. **23** (1984) 378.
84Sha Shablaev, S.I., Danishevskii, A.M., Subashiev, V.K.: Fiz. Tverd. Tela **26** (1984) 179; Sov. Phys. Solid State (English Transl.) **26** (1984) 105.
84Shi Shibahara, H., Hashimoto, H.: J. Cryst. Growth **67** (1984) 227.
85Aga Agal'tsov, A.M., Gorelik, V.S., Moiseenko, V.N.: Sb. Kratk. Soobshch. Fiz., Akad. Nauk SSSR, Fiz. Inst. P. N. Lebedeva, No. 5 (1985) 49; Sov. Phys. Lebedev Inst. Rep., No. 5 (1985) 55.
85Ari Arit, G., Hennings, D., de With, G.: J. Appl. Phys. **58** (1985) 1619.
85Beu Beudon, D., Le Bihan, R.: Jpn. J. Appl. Phys. **24**, Suppl. 24–2 (1985) 548.
85Foo Foote, M.C., Anderson, A.C.: Ferroelectrics **62** (1985) 11.
85Gun Gunter, P., Voit, E., Zha, M.Z., Albers, J.: Optics Commun. **55** (1985) 210.
85Her Hero, A., Gonser, U., Engelmann, H., Hagemann, H.J.: Ferroelectrics **65** (1985) 211.
85Iij Iijima, Y.: Jpn. J. Appl. Phys. **24**, Suppl. 24–2 (1985) 401.
85Koj Kojima, S.: Jpn. J. Appl. Phys. **24**, Suppl. 24–2 (1985) 553.
85Kut Kutty, T.R.N., Murugaraj, P., Gajbhiye, N.S.: Mater. Res. Bull. **20** (1985) 565.
85McW McWhan, D.B., Aeppli, G., Remeika, J.P., Nelson, S.: J. Phys. C **18** (1985) L307.
85Mul Muller, K.A., Berlinger, W., Albers, J.: Phys. Rev. B **32** (1985) 5837.
85Neu Neumann, D.A., McWhan, D.B., Littlewood, P., Aeppli, G., Remeika, J.P., Maines, R.G.S.: Phys. Rev. B **32** (1985) 1866.
85Saw1 Sawaguchi, E., Akishige, Y., Kobayashi, M.: Jpn. J. Appl. Phys. **24**, Suppl. 24–2 (1985) 252.
85Saw2 Sawaguchi, E., Akishige, Y., Kobayashi, M.: J. Phys. Soc. Jpn. **54** (1985) 480.
85Tur Turik, A.V., Khasabova, G.I., Sidorenko, E.N.: Fiz. Tverd. Tela **27** (1985) 1079; Sov. Phys. Solid State (English Transl.) **27** (1985) 653.
86Aki Akishige, Y., Yokozeki, N., Kobayashi, M., Sawaguchi, E.: Solid State Commun. **60** (1986) 445.
86Bur Bursill, L.A., Peng, J.L.: Ferroelectrics **70** (1986) 191.
86Gav Gavrilyachenko, V.G., Semenchev, A.F., Fesenko, E.G.: Fiz. Tverd. Tela **28** (1986) 3126; Sov. Phys. Solid State (English Transl.) **28** (1986) 1758.
86God Godefroy, G., Ormancey, G., Jullien, P., Ousi-Benomar, W., Semanou, Y.: Proc. IEEE Int. Symp. Appl. Ferroelectr., 6 th, Bethlehem, PA, 1986, p. 12.
86HuY Hu, Y.H., Chan, H.M., Zhang, X.W., Parmer, M.P.: J. Am. Ceram. Soc. **69** (1986) 594.
86Kos Koschek, G., Kubalek, E.: Ferroelectrics **68** (1986) 293.
86Mal Malinowski, M., Lukaszewicz, K., Asbrink, S.: J. Appl. Crystallogr. **19** (1986) 7.
86Mul Müller, K.A., Berlinger, W.: Phys. Rev. B **34** (1986) 6130.
86Rup Rupp, R.A., Dress, F.W.: Appl. Phys. B **39** (1986) 223.
86Sch Schaefer, A., Schmitt, H., Dorr, A.: Ferroelectrics **69** (1986) 253.
86Sha Shaikh, A.S., Vest, R.W., Vest, G.M.: Proc. IEEE Int. Symp. Appl. Ferroelectr., 6 th, Bethlehem, PA, 1986, p. 126.

86Vol Volkov, A.A., Goncharov, Yu.G., Kozlov, G.V.: Fiz. Tverd. Tela **28** (1986) 2104; Sov. Phys. Solid State (English Transl.) **28** (1986) 1176.
86Zim Zimmer, H.E., Engert, J., Frach, P., Henning, I., Hegenbarth, E.: Ferroelectr. Lett. **6** (1986) 33.
87Aki Akishige, Y., Sawaguchi, E.: Jpn. J. Appl. Phys. **26**, Suppl. 26–2 (1987) 123.
87Aru Arunachalam, L.M., Chakravorty, D., Subbarao, E.C.: Bull. Mater. Sci. **9** (1987) 159.
87Eas Eason, R.W., Smout, A.M.C.: Opt. Lett. **12** (1987) 51.
87Mot Motes, A., Kim, J.J.: J. Opt. Soc. Am. B **4** (1987) 1379.
87Yam Yamaguchi, H., Uwe, H., Sakudo, T., Sawaguchi, E.: J. Phys. Soc. Jpn. **56** (1987) 589.
88Aki1 Akishige, Y., Oome, G., Sawaguchi, E.: Solid State Commun. **62** (1988) 621.
88Aki2 Akishige, Y., Kobayashi, M., Takahashi, H., Mori, N., Sawaguchi, E.: Ferroelectrics **88** (1988) 89.
88Aki3 Akishige, Y., Atake, T., Saito, Y., Sawaguchi, E.: J. Phys. Soc. Jpn. **57** (1988) 718.
88AlA1 Al-Allak, H.M., Parry, T.V., Russell, G.J., Woods, J.: J. Mater. Sci. **23** (1988) 1083.
88AlA2 Al-Allak, H.M., Brinkman, A.W., Russell, G.J., Woods, J.: J. Appl. Phys. **63** (1988) 4530.
88AlA3 Al-Allak, H.M., Brinkman, A.W., Russell, G.J., Roberts, A.W., Woods, J.: J. Phys. D **21** (1988) 1226.
88Beu Beudon, D., Le Bihan, R., Lompre, P., Godefroy, G.: Ferroelectrics **81** (1988) 111.
88Bro Brost, G.A., Motes, R.A., Rotge, J.R.: J. Opt. Soc. Am. B **5** (1988) 1879.
88Deg Deguchi, K., Kobayashi, H., Nakamura, E., Yamaguchi, H., Uwe, H., Sakudo, T.: J. Phys. Soc. Jpn. **57** (1988) 4011.
88Gow Gower, M.C., Hribek, P.: J. Opt. Soc. Am. B **5** (1988) 1750.
88Ino Inoue, K., Hasegawa, A., Watanabe, K., Yamaguchi, H., Uwe, H., Sakudo, T.: Phys. Rev. B **38** (1988) 6352.
88Jan Jannin, M., Jannot, B., Lompre, P., Godefroy, G.: Ferroelectrics **81** (1988) 23.
88Jia Jiang, Y.-J., Li, J.-Z., Zheng, L.: Acta Phys. Sin. **37** (1988) 680.
88Ker Kersten, O., Rost, A., Schmidt, G.: Ferroelectrics **81** (1988) 31.
88Kov Kovaleva, L.A., Petrov, A.A., Anistratov, A.T.: Fiz. Tverd. Tela **30** (1988) 1827; Sov. Phys. Solid State (English Transl.) **30** (1988) 1050.
88Sch1 Schunemann, P.G., Pollak, T.M., Yang, Y., Teng, Y.-Y., Wong, C.: J. Opt. Soc. Am. B **5** (1988) 1702.
88Sch2 Schunemann, P.G., Temple, D.A., Hathcock, R.S., Tuller, H.L., Jenssen, H.P., Gabbe, D.R., Warde, C.: J. Opt. Soc. Am. B **5** (1988) 1685.
88Yam1 Yamamoto, T., Akishige, Y., Sawaguchi, E.: J. Phys. Soc. Jpn. **57** (1988) 3665.
88Yam2 Yamaguchi, H., Uwe, H., Sakudo, T., Sawaguchi, E.: J. Phys. Soc. Jpn. **57** (1988) 147.
89Aki Akishige, Y., Oomi, G., Yamamoto, T., Sawaguchi, E.: J. Phys. Soc. Jpn. **58** (1989) 930.
89Che Cheng, H.: J. Appl. Phys. **66** (1989) 1382.
89Dav Davis, G.M., Gower, M.C.: Appl. Phys. Lett. **55** (1989) 112.
89Dec Decker, D.L., Zhao, Y.X.: Phys. Rev. B **39** (1989) 2432.
89Dia Diaz-Guemes, M.I., Gonzalez Carreno, T., Serna, C.J.: Spectrochim. Acta **45A** (1989) 589.
89Flo Flores-Ramirez, R., Huanosta, A., Amano, E., Valenzuela, R., West, A.R.: Ferroelectrics **99** (1989) 195.
89For Ford, J.E., Fainman, Y., Lee, S.H.: Appl. Opt. **28** (1989) 4808.
89Hal Hall, D.A., Moulson, A.J.: Euro-Ceramics, Vol. 2: Properties of Ceramics [Proceedings of the 1st European Ceramic Society Conference, June 1989, Maastricht], de With, G., Terpstra, R.A., Metselaar, R. (eds.), Essex: Elsevier Science Publishers Ltd, 1989, p. 370.
89Ish Ishidate, T., Sasaki, S.: Phys. Rev. Lett. **62** (1989) 67.
89Jov Jovanobic, A., Wohlecke, M., Kapphan, S., Maillard, A., Godefroy, G.: J. Phys. Chem. Solids **50** (1989) 623.
89Jul Jullien, P., Maillard, A., Ormancey, G., Lahlafi, A., Matull, R.: Ferroelectrics **94** (1989) 81.
89Kas Kastner, G., Hilarius, V., Wagner, R., Burger, W.: J. Mater. Sci. Lett. **8** (1989) 959.
89Kle Kleint, C.A., Stopel, U., Rost, A.: Phys. Status Solidi (a) **115** (1989) 165.

89Ohi Ohi, K., Arai, H., Ishige, T., Shimokoshi, M.: Ferroelectrics **96** (1989) 3.
89Rad Radecka, M., Rekas, M.: React. Solids **7** (1989) 43.
89Sha Shaikh, A.S., Vest, R.W., Vest, G.M.: IEEE Trans. Ultrason. Ferroelectr. Freq. Control **36** (1989) 407.
89Shi Shin, R.-C., Kim, H.: Ferroelectrics **89** (1989) 81.
89Sin Sinclair, D.C., West, A.R.: J. Appl. Phys. **66** (1989) 3850.
89Uch Uchino, K., Sadanaga, E., Hirose, T.: J. Am. Ceram. Soc. **72** (1989) 1555.
89Yam Yamamoto, T., Akishige, Y., Sawaguchi, E.: Ferroelectrics **97** (1989) 189.
90Arm Armstrong, L.R., Young, K.A., Buchanan, R.C.: J. Am. Ceram. Soc. **73** (1990) 700.
90Bat Batllo, F., Duverger, E., Jules, J., Niepce, J.-C., Jannot, B., Maglione, M.: Ferroelectrics **109** (1990) 113.
90Bog Boggess, T.F., White, J.O., Valley, G.C.: J. Opt. Soc. Am. B **7** (1990) 2255.
90Bor Borodin, V.Z., Eknadiosiants, E.I., Schneider, E.Y., Borodina, V.A., Pinskaya, A.N.: Ferroelectrics **111** (1990) 271.
90Bro Brost, G.A., Motes, R.A.: Opt. Lett. **15** (1990) 1194.
90Bur Burns, G., Dacol, F.H., Albers, J.: Ferroelectrics **108** (1990) 153.
90End Endo, T., Kobayashi, T., Sato, T., Shimada, M.: J. Mater. Sci. **25** (1990) 619.
90Hol Holtmann, L., Unland, M., Kratzig, E., Godefroy, G.: Appl. Phys. A **51** (1990) 13.
90Iij Iijima, K., Terashima, T., Yamamoto, K., Hirata, K., Bando, Y.: Appl. Phys. Lett. **56** (1990) 527.
90Ish Ishizawa, N., Banno, H., Hayashi, M., Yoo, S.E., Yoshimura, M.: Jpn. J. Appl. Phys. **29** (1990) 2467.
90Jul Jullien, P., Lahlafi, A., Maillard, A., Ormancey, G.: Ferroelectrics **108** (1990) 147.
90Laa Laabidi, K., Fontana, M.D., Jannot, B.: Solid State Commun. **76** (1990) 765.
90Mah Mahgerefteh, D., Feinberg, J.: Phys. Rev. Lett. **64** (1990) 2195; erratum: **65** (1990) 2613.
90Nas Nasser, S.A.: J. Mater. Sci. Lett. **9** (1990) 1453.
90Saw Sawaguchi, E., Akishige, Y., Yamamoto, T.: Ferroelectrics **106** (1990) 63.
90Shi Shimokoshi, M., Ohi, K.: J. Phys. Soc. Jpn. **59** (1990) 3629.
90Tem Temple, D.A., Hathcock, R.S., Warde, C.: J. Appl. Phys. **67** (1990) 6667.
90Yok Yoko, T., Kamiya, K., Tanaka, K.: J. Mater. Sci. **25** (1990) 3922.
91Aki Akishige, Y., Nakahara, J., Sawaguchi, E.: J. Phys. Soc. Jpn. **60** (1991) 1115.
91Cas Castet-Mejean, L.: Phase Transitions **36** (1991) 3.
91Fer Fernandez, J.F., Duran, P., Moure, C.: J. Mater. Sci. **26** (1991) 3257.
91Fes Fesenko, E.G., Dantsiger, A.Ya., Dudkina, S.I., Dergunova, N.V., Rasumovskaya, O.N., Resnichenko, L.A., Shilkina, L.A.: Izv. Akad. Nauk SSSR, Neorg. Mater. **27** (1991) 424; Inorg. Mater. (English Transl.) **27** (1991) 337.
91Igu Iguchi, E., Kubota, N., Nakamori, T., Yamamoto, N., Lee, K.J.: Phys. Rev. B **43** (1991) 8646.
91Kaj Kajiyoshi, K., Ishizawa, N., Yoshimura, M.: J. Am. Ceram. Soc. **74** (1991) 369.
91Kaw Kawano, H., Morii, K., Nakayama, Y.: Mater. Lett. **12** (1991) 252.
91Kir Kirby, K.W., Wechsler, B.A.: J. Am. Ceram. Soc. **74** (1991) 1841.
91Kle Klein, J.D., Yen, A.: J. Appl. Phys. **70** (1991) 505.
91Kwa Kwak, B.S., Zhang, K., Boyd, E.P., Erbil, A., Wilkens, B.J.: J. Appl. Phys. **69** (1991) 767.
91Law Lawler, W.B., Sherman, C.J., Moharam, M.G.: J. Opt. Soc. Am. B **8** (1991) 2190.
91McK McKee, R.A., Walker, F.J., Conner, J.R., Specht, E.D., Zelmon, D.E.: Appl. Phys. Lett. **59** (1991) 782.
91Nak Nakazawa,H., Yamane, H., Hirai,T.: J. Ceram. Soc. Jpn. **99** (1991) 527; J. Ceram. Soc. Jpn. Internat. Ed. **99** (1991) 514.
91Nor Norton, M.G., Scarfone, C., Li, J., Carter, C.B., Mayer, J.W.: J. Mater. Res. **6** (1991) 2022.
91Pan1 Panwar, N.S., Semwal, B.S.: Pramana **36** (1991) 163.
91Pan2 Panwar, N.S., Semwal, B.S.: Ferroelectrics **115** (1991) 1.

91Sar Sarah, P., Bhimasankaram, T., Kumar, G.S., Suryanarayana, S.V.: Cryst. Res. Technol. **26** (1991) 1085.
91Tem Temple, D.A., Warde, C.: Appl. Phys. Lett. **59** (1991) 4.
91Yam Yamaguchi, H., Yamada, A., Uwe, H., Sakudo, T.: Phys. Rev. B **43** (1991) 4473.
92Abd Abdi, F., Fontana, M.D., Aillerie, M.: Ferroelectrics **134** (1992) 1.
92Aji Ajimura, S., Tomomatsu, K., Nakao, O., Kurosaka, A., Tominaga, H. Fukuda, O.: J. Opt. Soc. Am. B **9** (1992) 1609.
92Che Chern, C.S, Zhao, J., Luo, L., Lu, P., Li, Y.Q., Norris, P., Kear, B., Cosandey, F., Maggiore, C.J., Gallois, B., Wilkens, B.J.: Appl. Phys. Lett. **60** (1992) 1144.
92Coh Cohen, R.E., Krakauer, H.: Ferroelectrics **136** (1992) 65.
92Cud Cudney, R.S., Pierce, R.M., Bacher, G.D., Mahgerefteh, D., Feinberg, J.: J. Opt. Soc. Am. B **9** (1992) 1704.
92Emo Emoto, H., Hojo, J.: J. Ceram. Soc. Jpn. **100** (1992) 555; J. Ceram. Soc. Jpn. Internat. Ed. **100** (1992) 553.
92Gil Gillot, C., Michenaud, J.P., Maglione, M., Jannot, B.: Solid State Commun. **84** (1992) 1033.
92Kaz Kazaoui, S., Ravez, J., Elissalde, C., Maglinone, M.: Ferroelectrics **135** (1992) 85.
92Pos Possenriede, E., Jacobs, P., Kröse, H., Schirmer, O.F.: Appl. Phys. A **55** (1992) 73.
92Roy Roy, D., Krupanidhi, S.B.: Appl. Phys. Lett. **61** (1992) 2057.
92Sch Schwartz, R.N., Wechsler, B.A., McFarlane, R.A.: Phys. Rev. B **46** (1992) 3263.
92Shi Shiojiri, M., Isshiki, T., Saijo, H., Tsujikura, M., Nakada, A., Nakano, Y., Ikeda, M., Nomura, T.: Phys. Status Solidi (a) **129** (1992) 353.
92Tsa1 Tsai, F., Khiznichenko, V., Cowley, J.M.: Ultramicroscopy **45** (1992) 55.
92Tsa2 Tsai, F., Cowley, J.M.: Ultramicroscopy **45** (1992) 43.
92Van Van Buskirk, P.C, Gardiner, R., Kirlin, P.S., Nutt, S.: J. Mater. Res. **7** (1992) 542.
92WuK1 Wu, K.-W., Schulze, W.A.: J. Am. Ceram. Soc. **75** (1992) 3385.
92WuK2 Wu, K.-W., Schulze, W.A.: J. Am. Ceram. Soc. **75** (1992) 3390.
92Zhu Zhu, Y.,Wang, D., Wu, X., Yang, H., Zhang, D., Jiang, Y., Ye, P.: Opt. Commun. **93** (1992) 333.
93Bie1 Biedrzycki, K., Aboura, H., Bihan, R.L.: Phys. Status Solidi (a) **140** (1993) 257.
93Bie2 Biedrzycki, K., Hajir, D., Le Bihan, R.: Ferroelectrics **140** (1993) 235.
93Bus Buse, K., Riehemann, S., Loheide, S., Hesse, H., Mersch, F., Kratzig, E: Phys. Status Solidi (a) **135** (1993) K87.
93Des Desu, S.B.: J. Electrochem. Soc. **140** (1993) 2981.
93Fan Fang, T.-T., Hsieh, H.-L., Shian, F.-S.: J. Am. Ceram. Soc. **76** (1993) 1205.
93Hay Hayashi, T., Ohji, N., Hirohara, K., Fukunaga, T., Maiwa, H.: Jpn. J. Appl. Phys. **32** (1993) 4092.
93Hsi Hsiang, H.-I., Yen, F.-S.: Jpn. J. Appl. Phys. **32** (1993) 5029.
93Hud1 Hudson, L.T., Kurtz, R.L., Robey, S.W., Temple, D., Stockbauer, R.L.: Phys. Rev. B **47** (1993) 1174.
93Hud2 Hudson, L.T., Kurtz, R.L., Robey, S.W., Temple, D., Stockbauer, R.L.: Phys. Rev. B **47** (1993) 10832.
93Kam Kamalasanan, M.N., Kumar, N.D., Chandra, S.: J. Appl. Phys. **74** (1993) 5679.
93Kim Kim, T.W., Jung, M., Kim, H.J., Yoon, Y.S., Kang, W.N., Yom, S.S.: Appl. Phys. Lett. **62** (1993) 1788.
93Kor Kordi Ardakani, H., Shushtarian, S.S., Kanetkar, S.M., Karekar, R.N., Ogale, S.B.: J. Mater. Sci. Lett. **12** (1993) 63.
93Kuw Kuwabara, M., Takahashi, S., Kuroda, T.: Appl. Phys. Lett. **62** (1993) 3372.
93Nas Nashimoto, K., Fork, D.K., Ponce, F.A., Tramontana, J.C.: Jpn. J. Appl. Phys. **32** (1993) 4099.
93Osa Osawa, S., Furuzawa, A., Fujikawa, N.: J. Am. Ceram. Soc. **76** (1993) 1191.
93Zha Zhang, X., Joy, D.C., Zhang, Y., Hashimoto, T., Allard, L., Nolan, T.A.: Ultramicroscopy **51** (1993) 21.

94Aki1 Akimoto, J., Gotoh, Y., Oosawa, Y.: Acta Crystallogr., Sect. C **50** (1994) 160.
94Aki2 Akishige, Y., Takahashi, H., Mori, N., Sawaguchi, E.: J. Phys. Soc. Jpn. **63** (1994) 1590.
94Aki3 Akishige, Y., Kamishina, Y., Nakahara, J., Sawaguchi, E.: Ferroelectrics **152** (1994) 225.
94Boc Bochynski, Z.: Ferroelectrics **157** (1994) 13.
94Cud Cudney, R.S., Fousek, J., Zgonik, M., Gunter, P., Garrett, M.H., Rytz, D.: Ferroelectrics **157** (1994) 45.
94Dou Dougherty, T.P., Wiederrecht, G.P., Nelson, K.A., Garrett, M.H., Jenssen, H.P., Warde, C.: Phys. Rev. B **50** (1994) 8996.
94Fon Fontana, M.D., Laabidi, K., Jannot, B.: J. Phys. Condens. Matter **6** (1994) 8923.
94Gil1 Gillot, C., Michenaud, J.P.: J. Phys. D **27** (1994) 2180.
94Gil2 Gillot, C., Michenaud, J.P.: Solid State Commun. **90** (1994) 23.
94Kan Kanert, O., Schultz, H., Albert, J.: Solid State Commun. **91** (1994) 465.
94Kim Kim, I.T., Lee, C.H., Park, S.J.: Jpn. J. Appl. Phys. **33** (1994) 5125.
94Laa Laabidi, K., Fontana, M.D., Maglione, M., Jannot, B., Muller, K.A.: Europhys. Lett. **26** (1994) 309.
94LiZ Li, Z., Grimsditch, M., Chan, S.-K.: Ferroelectrics **159** (1994) 121.
94Ohi Ohi, K., Matsumoto, J., Tanaka, T., Ohmori, E.: Ferroelectrics **156** (1994) 339.
94Par1 Park, B.M., Chung, S.J.: Ferroelectrics **157** (1994) 27.
94Par2 Park, B.M., Chung, S.J.: J. Am. Ceram. Soc. **77** (1994) 3193.
94Pos Possenriede, E., Krose, H., Varnhorst, T., Scharfschwerdt, R., Schirmer, O.F.: Ferroelectrics **151** (1994) 199.
94Rec Recnik, A., Bruley, J., Mader, W., Kolar, D., Ruhle, M.: Philos. Mag. B **70** (1994) 1021.
94Sch Schlag, S., Eicke, H.: Solid State Commun. **91** (1994) 883.
94Smy Smyth, D.M.: Ferroelectrics **151** (1994) 115.
94Tsa Tsai, F., Cowley, J.M.: Appl. Phys. Lett. **65** (1994) 1906.
94War Warren, W.L., Dimos, D., Tuttle, B.A., Smyth, D.M.: J. Am. Ceram. Soc. **77** (1994) 2753.
94Wat Watanabe, Y., Matsumoto, Y., Kunitomo, H., Tanamura, M: Jpn. J. Appl. Phys. **33** (1994) 5182.
94Wec Wechsler, B.A., Klein, M.B., Nelson, C.C., Schwartz, R.N.: Opt. Lett. **19** (1994) 536.
94XuY Xu, Y.-N., Jiang, H., Zhong, X.-F., Chin, W.Y.: Ferroelectrics **153** (1994) 19.
94Yam1 Yamanaka, A., Inoue, K., Furutani, T., Kawamata, J., Yamaguchi, H.: Ferroelectrics **159** (1994) 79.
94Yam2 Yamamoto, T., Sakuma, T.: J. Am. Ceram. Soc. **77** (1994) 1107.
94Yan Yang, C., Zhu, Y., Hui, M., Niu, X., Liu, H., Wu, X.: Opt. Commun. **109** (1994) 318.
94Yas Yasuda, N., Kato, T., Hirai, T., Mizuno, M., Kurachi, K., Taga, I.: Ferroelectrics **154** (1994) 331.
94Zgo Zgonik, M., Bernasconi, P., Duelli, M., Schlesser, R., Gunter, P., Garrett, M.H., Rytz, D., Zhu, Y., Wu, X.: Phys. Rev. B **50** (1994) 5941.
94Zha1 Zhang, M.-S., Yin, Z., Chen, Q., Dimza, V.I.: Ferroelectrics **152** (1994) 415.
94Zha2 Zhang, X., Joy, D.C., Allard, L.F., Nolan, T.A.: Ferroelectrics **157** (1994) 159.
95Aki1 Akishige, Y.: J. Phys. Soc. Jpn. **64** (1995) 4033.
95Aki2 Akishige, Y., Kamishine, Y.: Ferroelectrics **168** (1995) 121.
95Kaw Kawahara, T., Yamamuka, M., Yuuki, A., Ono, K.: Jpn. J. Appl. Phys. **34** (1995) 5077.
95Sak Sakayori, K., Matsui, Y., Abe, H., Nakamura, E., Kenmoku, M., Hara, T., Ishikawa, D., Kokubu, A., Hirota, K., Ikeda, T.: Jpn. J. Appl. Phys. **34** (1995) 5443.
95Yam Yamaguchi, M., Inoue, K., Yagi, T., Akishige, Y.: Phys. Rev. Lett. **74** (1995) 2126.
95Yar Yaremko, A.M., Ostrovskii, D.I.: J. Phys. Condens. Matter **7** (1995) 7833.
96Yam Yamanaka, A., Inoue, K.: Physica B **219-220** (1996) 620.