List of terms and symbols used in this volume

(1) *Vector spaces and tensor analysis*

Basis vectors in direct space (covariant)	$\mathbf{e}_i$, $\mathbf{a}_i$
Basis vectors in reciprocal space (contravariant)	$\mathbf{e}^i$, $\mathbf{a}_i^*$
Contravariant components of vectors in direct space	x^i
Covariant components of vectors in reciprocal space	x_i
Direction indices (of a lattice row)	$[uvw]$
Dual (or reciprocal) space (n dimensions)	E_n (Chapter 1.1)
Element of	$\in$
Euclidian space, direct space (n dimensions)	E^n
Hermitian conjugate of matrix M	M^+
Integers (positive)	$\mathbb{Z}^+$
Integers (ring of)	$\mathbb{Z}$
Kronecker symbol	δ_i^j
Metric tensor	g_{ij}
Miller indices (of a lattice plane)	(hkl)
Nabla operator	∇
Orthogonal transformation	R
Outer product	$\bigwedge$
Partial derivative with respect to x_i	∂_i
Permutation tensor	ε_{ijk}, $\hat{e}_{ijk}$
Position vector in reciprocal space	$\mathbf{G}$, $\mathbf{k}$
Reciprocal lattice vector	$\mathbf{g}_{hkl}$
Sum of spaces	$\oplus$
Tensor of rank n, p times covariant and q times contravariant ($n = p + q$)	$t_{i_1 \ldots i_p}^{j_1 \ldots j_q}$
Tensor product	$\otimes$
Transpose of matrix M	M^T
Unit transformation, matrix or element	E
Vector in superspace	$\mathbf{a}_{\mathrm{si}}$
Vector in reciprocal superspace	$\mathbf{a}_{\mathrm{si}}^*$
Vector product	$\wedge$, $\times$
Volume element	$\mathrm{d}\tau$
Volume of unit cell in direct (reciprocal) space	V (V^*)

(2) *Group theory*

Character	χ
Character (irreducible)	χ_α
Character (value at R)	$\chi(R)$
Class multiplication constants	c_{ijk}
Conjugacy class	C_i
Cyclic group of order m	C_m
Dihedral group of order $2n$	D_n
Dimension of irreducible representation α	d_α
Lattice translation subgroup	$T(n)$
Matrix representation of point group K	$\Gamma(K)$
Multiplicity	m_α
Octahedral group	O
Order of class C_i	n_i
Orthogonal group	$O(n)$
Orthogonal group (special)	$SO(n)$
Physically irreducible representation	R-irep
Point group	K (Chapter 1.2), G_o (Chapter 2.1), G (Part 3)
Point group (order of)	$\lvert K\rvert$, N
Representation of point group K	$D(K)$
Space group	G, $\mathcal{G}$ (Part 3)
Tetrahedral group	T

(3) *Physical properties*

(*a*) *Elastic properties*

Bulk modulus (volume isothermal compressibility)	κ
Components of the displacement vector	u_i
Elastic compliances (second-order)	s_{ijkl}
Elastic compliances (second-order adiabatic)	$(s_{ijkl})^\sigma$
Elastic compliances (second-order reduced)	$s_{\alpha\beta}$
Elastic compliances (third-order)	s_{ijklmn}
Elastic stiffnesses (second-order)	c_{ijkl}, C_{ijkl}
Elastic stiffnesses (second-order adiabatic)	$(c_{ijkl})^\sigma$
Elastic stiffnesses (second-order reduced)	$c_{\alpha\beta}$
Elastic stiffnesses (third-order)	c_{ijklmn}
Lamé coefficients	λ
Normal stress	$\vec{\nu}$
Poisson's ratio	ν
Pressure	p
Shear stress	$\vec{\tau}$
Strain tensor	S_{ij}, u_{ij} (Chapters 1.4, 1.5 and 3.1), η_{ij} (Chapter 2.3)
Strain Voigt matrix	S_α
Stress tensor	T_{ij}, τ_{ij} (Chapter 1.4), σ_{ij} (Chapters 2.1, 2.3, 2.4)
Stress Voigt matrix	T_α
Velocity of sound	v
Volume	V
Volumic mass	ρ
Young's modulus	E

(*b*) *Electric properties*

Charge density	$\rho(\mathbf{r})$
Charge of the electron	e
Current density	$\mathbf{j}(\mathbf{r})$, J
Dielectric impermeability	η_{ij}
Dielectric permittivity or constant	ε
Dielectric permittivity of vacuum	ε_0
Dielectric permittivity tensor	ε_{ij}
Dielectric permittivity tensor (adiabatic)	$(\varepsilon_{ij})^\sigma$
Dielectric susceptibility	χ_{ij}^e, $\chi_{ijk\ldots}$
Dielectric susceptibility (nth-order)	$\chi^{(n)}$
Effective mass of the electron	m^*
Electric dipole operator	$\hat{p}$
Electric displacement	$\mathbf{D}$
Electric field	$\mathbf{E}$
Electric polarization	$\mathbf{P}$
Electric polarization (nth-order)	$\mathbf{P}_n$
Electric polarization (nonlinear)	$\mathbf{P}^{\mathrm{NL}}$
Electro-optic tensor	r_{ijk}
Electrostriction tensor	Q_{ijkl}
Electrostriction tensor (reduced)	$Q_{\alpha\beta}$
Hall constant	$R_{H\ ijk}$
Piezoelectric tensor	d_{ijk}

Piezoelectric tensor at constant strain	e_{ijk}
Piezoelectric tensor (reduced)	$d_{i\alpha}$
Piezoelectric tensor (reduced adiabatic)	$(d_{ijk})^{\sigma}$
Piezoelectric tensor (reduced inverse)	$d_{\alpha i}$
Pyroelectric tensor	p_i

(*c*) *Magnetic properties*

Antiferromagnetic vector	$\mathbf{L}_i$
Bohr magneton	μ_B
Constant describing magnetostriction	λ
Effective number of Bohr magnetons	p (Section 1.6.1)
Landé g-factor	g
Magnetic birefringence	Δn
Magnetic field	$\mathbf{H}$
Magnetic induction	$\mathbf{B}$
Magnetic moment	$\boldsymbol{\mu}$
Magnetic moment density	$\mathbf{m}(\mathbf{r})$
Magnetic permeability	μ_{ij}
Magnetic permeability of vacuum	μ_o
Magnetic susceptibility	χ_{ij}, χ_{ij}^{m}
Magnetization (= magnetic moment per unit volume = ferromagnetic vector)	$\mathbf{M}$
Magnetoelastic energy	U_{me}
Magnetoelectric tensor (linear)	α_{ij}
Magnetoelectric tensor (nonlinear) *EHH*	β_{ijk}
Magnetoelectric tensor (nonlinear) *HEE*	γ_{ijk}
Magneto-optic tensor	$\mathbf{f}$
Néel temperature	T_N
Orbital angular momentum	$\mathbf{L}$ (Section 1.6.1.1)
Piezomagnetic components	Λ_{ijk}
Piezomagnetic components (reduced)	$\Lambda_{i\alpha}$
Piezomagnetoelectric tensor	π_{ijkl}
Spin angular momentum (of an atom or ion)	$\mathbf{S}$
Spin density	$\mathbf{S}(\mathbf{r})$
Sum of the magnetic moments in a unit cell	$\mathbf{m}$
Sum of the magnetic moments in a unit cell, in which some of the moments are taken with opposite sign	$\mathbf{l}_i$
Total angular momentum	$\mathbf{J}$
Weiss constant	Δ

(*d*) *Optical properties*

Angle between optic axes	$2V$
Cyclic (or circular) frequency	ω
Elasto-optic (strain-optic) tensor	p_{ijkl}
Elasto-optic (strain-optic) tensor, reduced	$p_{\alpha\beta}$
Electro-optic tensor	r_{ijk}
Ellipticity of wave	κ
Gyration susceptibility	γ_{ijl}
Gyration tensor	g_{ij}, G_{ij}
Gyration vector	$\mathbf{G}$
Optical rotatory power	ρ
Phase difference of light	Δ
Piezo-optic tensor	π_{ijkl}
Piezo-optic tensor (reduced)	$\pi_{\alpha\beta}$
Polarizability operator	$\hat{\alpha}$
Poynting vector	$\mathbf{S}$
Poynting vector (unit)	$\mathbf{s}$, $\hat{\mathbf{s}}$
Raman tensor	$R^j(\mathbf{q})$
Rayleigh length	Z_r
Refractive index (extraordinary)	n_e
Refractive index of light	n
Refractive index (ordinary)	n_o
Refractive indices for biaxial indicatrix	n_x, n_α, α; n_y, n_β, β; n_z, n_γ, γ
Velocity of light in a vacuum	c
Velocity (group)	v_g
Wavelength of light	λ
Wavevector of light propagating in crystal	$\mathbf{k}$ ($\lvert k\rvert = 2\pi/\lambda$)

(*e*) *Thermodynamic properties*

Anisotropy energy	U_a
Atomic Debye–Waller factor (static)	S_α
Atomic Debye–Waller factor (thermal)	T_α
Boltzmann constant	k_B
Debye frequency	ω_D
Debye temperature	Θ_D
Einstein frequency	ω_E
Einstein temperature	Θ_E
Elastic energy	U_{el}
Entropy	σ, S
Free energy	$\mathcal{G}$, $\mathcal{F}$, F, A
Grüneisen parameter	$\bar{\gamma}$, γ
Grüneisen parameter (averaged mode)	$\gamma_{\mathbf{q},j}$
Grüneisen parameter (generalized mode)	$\gamma_{\mathbf{q}j,kl}$
Hamiltonian	H
Heat current	J_Q
Internal energy	U, $\mathcal{U}$
Lattice energy	E_{ph}
Partition function	Z
Phonon wavevector	$\mathbf{q}$
Seebeck coefficient	S
Specific heat at constant strain (volume)	c^S, c_V
Specific heat at constant stress (pressure)	c^T, c_p
Specific heat at constant volume (according to the Debye model)	c_V^{Debye}
Specific heat at constant volume (according to the Einstein model)	c_V^{Einstein}
Temperature	Θ, T
Temperature-stress components	λ_{ij}
Thermal conductivity	K
Thermal expansion	α_{ij}
Thermal expansion (volume)	β
Thermodynamic potential	Φ
Zero-point energy	E_o

(*f*) *Local crystal susceptibilities*

Local susceptibility tensor in direct space	$\chi(\mathbf{r})$
Fourier components of the local susceptibility tensor	$\chi(\mathbf{H})$
Dipole–dipole tensor atomic factor	D_{jk}
Symmetric part of the dipole–dipole tensor atomic factor	D_{jk}^{+}
Antisymmetric part of the dipole–dipole tensor atomic factor	D_{jk}^{-}
Third-rank tensor describing the dipole–quadrupole resonant X-ray scattering	I_{jkl}
Part of the third-rank tensor invariant under time inversion and symmetric under the permutation of j and k	I_{jkl}^{++}

Part of the third-rank tensor non-invariant under time inversion and symmetric under the permutation of j and k	I_{jkl}^{+-}
Part of the third-rank tensor invariant under time inversion and antisymmetric under the permutation of j and k	I_{jkl}^{-+}
Part of the third-rank tensor non-invariant under time inversion and antisymmetric under the permutation of j and k	I_{jkl}^{--}
Fourth-rank tensor describing the quadrupole–quadrupole resonant X-ray scattering	Q_{ijkl}

(4) *Phase transformations and twinning*

Order parameter (primary)	η
Order parameter (secondary)	λ
Point group of ferroic (low-symmetry) phase	F (Chapters 3.1 and 3.4)
Point group of parent (high-symmetry) phase	G
Space group of ferroic (low-symmetry) phase	$\mathcal{F}$ (Chapters 3.1 and 3.4)
Space group of parent (high-symmetry) phase	$\mathcal{G}$
Symmetry descent from G to F (point groups)	$G \Downarrow F$
Symmetry descent from $\mathcal{G}$ to $\mathcal{F}$ (space groups)	$\mathcal{G} \Downarrow \mathcal{F}$
Eigensymmetry of untwinned crystal or daughter phase	$\mathcal{H}$ (Chapter 3.3)
Transition temperature, in particular: Curie temperature	T_C
Order of group $\mathcal{G}$, $\mathcal{H}$, $\mathcal{K}$	$\|\mathcal{G}\|$, $\|\mathcal{H}\|$, $\|\mathcal{K}\|$
Index of $\mathcal{H}$ in $\mathcal{G}$, or of $\mathcal{H}$ in $\mathcal{K}$	$[i]$
Aizu symbol of a ferroic phase transition (ferroic species); F = ferroic	$\mathcal{G}F\mathcal{H}$ or $\mathcal{G} > F$
Composite symmetry group of a twinned crystal (domain pair); twin symmetry	$\mathcal{K}$
Reduced composite symmetry of the domain pair (1, 2)	$\mathcal{K}_{1,2}^{*}$, $\mathcal{K}^{*}$
Extended composite symmetry of a twinned crystal with a pseudo n-fold twin axis	$\mathcal{K}(n)$