

## List of terms and symbols (from Volume D)

### (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)	$E_n$
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	$\delta_i^j$
Metric tensor	$g_{ij}$
Miller indices (of a lattice plane)	$(hkl)$
Nabla operator	$\nabla$
Orthogonal transformation	$R$
Outer product	$\wedge$
Partial derivative with respect to $x_i$	$\partial_i$
Permutation tensor	$\varepsilon_{ijk}, \hat{e}_{ijk}$
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 ( $n = P + q$ )	$t_{i_1 \dots i_p}^{j_1 \dots j_q}$
Tensor product	$\otimes$
Transpose of matrix $M$	$M^T$
Unit transformation, matrix or element	$E$
Vector in superspace	$\mathbf{a}_{si}$

Vector in reciprocal superspace	$\mathbf{a}_{\text{si}}^*$
Vector product	$\wedge, \times$
Volume element	$d\tau$
Volume of unit cell in direct (reciprocal) space	$V (V^*)$

## (2) *Group theory*

Character	$\chi$
Character (irreducible)	$\chi_\alpha$
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 $\alpha$	$d_\alpha$
Lattice translation subgroup	$T(n)$
Matrix representation of point group $K$	$\Gamma(K)$
Multiplicity	$m_\alpha$
Octahedral group	$O$
Order of class $C_i$	$n_i$
Orthogonal group	$O(n)$
Orthogonal group (special)	$SO(n)$
Physically irreducible representation	$R\text{-irep}$
Point group	$K, G_o, G$
Point group (order of)	$ K , N$
Representation of point group $K$	$D(K)$
Space group	$G, \mathcal{G}$
Tetrahedral group	$T$

## (3) *Physical properties*

### (a) *Elastic properties*

Bulk modulus (volume isothermal compressibility)	$\kappa$
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	$\lambda$
Normal stress	$\vec{\nu}$
Poisson's ratio	$\nu$
Pressure	$p$
Shear stress	$\vec{\tau}$
Strain tensor	$S_{ij}, u_{ij}, \eta_{ij}$
Strain Voigt matrix	$S_\alpha$
Stress tensor	$T_{ij}, \tau_{ij}, \sigma_{ij}$
Stress Voigt matrix	$T_\alpha$
Velocity of sound	$v$
Volume	$V$
Volumic mass	$\rho$
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	$\eta_{ij}$
Dielectric permittivity or constant	$\varepsilon$
Dielectric permittivity of vacuum	$\varepsilon_0$
Dielectric permittivity tensor	$\varepsilon_{ij}$
Dielectric permittivity tensor (adiabatic)	$(\varepsilon_{ij})^\sigma$

Dielectric susceptibility	$\chi_{ij}^e, \chi_{ijk} \dots$
Dielectric susceptibility ( $n$ th-order)	$\chi^{(n)}$
Effective mass of the electron	$m^*$
Electric dipole operator	$\hat{p}$
Electric displacement	<b>D</b>
Electric field	<b>E</b>
Electric polarization	<b>P</b>
Electric polarization ( $n$ th-order)	$\mathbf{P}_n$
Electric polarization (nonlinear)	$\mathbf{P}^{\text{NL}}$
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	$\mu_B$
Constant describing magnetostriction	$\lambda$
Effective number of Bohr magnetons	$p$
Landé $g$ -factor	$g$
Magnetic birefringence	$\Delta n$
Magnetic field	<b>H</b>
Magnetic induction	<b>B</b>
Magnetic moment	$\mu$
Magnetic moment density	$\mathbf{m}(\mathbf{r})$
Magnetic permeability	$\mu_{ij}$

Magnetic permeability of vacuum	$\mu_o$
Magnetic susceptibility	$\chi_{ij}$ $\chi_{ij}^m$
Magnetization (= magnetic moment per unit volume = ferromagnetic vector)	<b>M</b>
Magnetoelastic energy	$U_{me}$
Magnetoelectric tensor (linear)	$\alpha_{ij}$
Magnetoelectric tensor (nonlinear) <i>EHH</i>	$\beta_{ijk}$
Magnetoelectric tensor (nonlinear) <i>HEE</i>	$\gamma_{ijk}$
Magneto-optic tensor	<b>f</b>
Néel temperature	$T_N$
Orbital angular momentum	<b>L</b>
Piezomagnetic components	$\Lambda_{ijk}$
Piezomagnetic components (reduced)	$\Lambda_{i\alpha}$
Piezomagnetoelectric tensor	$\pi_{ijkl}$
Spin angular momentum (of an atom or ion)	<b>S</b>
Spin density	<b>S(r)</b>
Sum of the magnetic moments in a unit cell	<b>m</b>
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	<b>J</b>
Weiss constant	$\Delta$

*(d) Optical properties*

Angle between optic axes	$2V$
Cyclic (or circular) frequency	$\omega$
Elasto-optic (strain-optic) tensor	$P_{ijkl}$
Elasto-optic (strain-optic) tensor, reduced	$P_{\alpha\beta}$
Electro-optic tensor	$r_{ijk}$
Ellipticity of wave	$\kappa$
Gyration susceptibility	$\gamma_{ijl}$
Gyration tensor	$g_{ij}, G_{ij}$
Gyration vector	<b>G</b>

Optical rotatory power	$\rho$
Phase difference of light	$\Delta$
Piezo-optic tensor	$\pi_{ijkl}$
Piezo-optic tensor (reduced)	$\pi_{\alpha\beta}$
Polarizability operator	$\hat{\alpha}$
Poynting vector	<b>S</b>
Poynting vector (unit)	<b>s</b> , $\hat{\mathbf{s}}$
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	$n_x, n_\alpha, \alpha; n_y, n_\beta, \beta; n_z, n_\gamma, \gamma$
Velocity of light in a vacuum	$c$
Velocity (group)	$v_g$
Wavelength of light	$\lambda$
Wavevector of light propagating in crystal	<b>k</b> ( $ k  = 2\pi/\lambda$ )

*(e) Thermodynamic properties*

Anisotropy energy	$U_a$
Atomic Debye-Waller factor (static)	$S_\alpha$
Atomic Debye-Waller factor (thermal)	$T_\alpha$
Boltzmann constant	$k_B$
Debye frequency	$\omega_D$
Debye temperature	$\Theta_D$
Einstein frequency	$\omega_E$
Einstein temperature	$\Theta_E$
Elastic energy	$U_{cl}$
Entropy	$\sigma, S$
Free energy	$\mathcal{G}, \mathcal{F}, F, A$
Grüneisen parameter	$\bar{\gamma}, \gamma$
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	$E_{\text{ph}}$
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)	$c_V^{\text{Debye}}$
Specific heat at constant volume (according to the Einstein model)	$c_V^{\text{Einstein}}$
Temperature	$\Theta, T$
Temperature-stress components	$\lambda_{ij}$
Thermal conductivity	$K$
Thermal expansion	$\alpha_{ij}$
Thermal expansion (volume)	$\beta$
Thermodynamic potential	$\Phi$
Zero-point energy	$E_o$

#### (4) *Phase transformations*

Aizu symbol of a ferroic phase transition	$\mathcal{GFH}$
Eigensymmetry of untwinned crystal or daughter phase	$\mathcal{H}$
Order parameter (primary)	$\eta$
Order parameter (secondary)	$\lambda$
Point group of ferroic (low-symmetry) phase	$F$
Point group of parent (high-symmetry) phase	$G$
Space group of ferroic (low-symmetry) phase	$\mathcal{F}$
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)	$\mathcal{G} \Downarrow \mathcal{F}$
Transition temperature, in particular: Curie temperature	$T_C$