Table 1.5.10.1. *Conversion of Gaussian to SI units*

Symbol	Quantity	Gaussian unit and its SI equivalent
$\mathbf{B}$	Magnetic induction	1 gauss (G) $= 10^{-4}$ tesla (T)
$\mathbf{H}$	Magnetic field	1 oersted (Oe) $= 10^3/(4\pi)$ A m^{-1}
$\mathbf{M}$	Magnetization (= magnetic moment per unit volume)	1 emu cm^{-3} $= 10^3$ A m^{-1}
α	Linear magnetoelectric tensor (rationalized units)	1 (dimensionless units) $= 4\pi\times10^{-8}/3$ s m^{-1}
Λ	Piezomagnetic tensor	1 Oe^{-1} $= 4\pi\times10^{-3}$ m A^{-1} $= 4\pi\times10^{-3}$ T Pa^{-1}
χ	Magnetic volume susceptibility	1 (dimensionless units) $= 4\pi$ (dimensionless units)
χ_g	Magnetic mass susceptibility	1 cm^3 g^{-1} $= 4\pi\times10^{-6}$ m^3 g^{-1}
$\chi_{\rm mol}$	Magnetic molar susceptibility	1 cm^3 mol^{-1} $= 4\pi\times10^{-6}$ m^3 mol^{-1}

We used here the modified equation (1.5.9.7):

$$\tfrac{1}{2}c_{ijk\ell}S^*_{ij}S^*_{k\ell} = -\tfrac{1}{2}V^0_{ij}S^*_{ij}. \qquad (1.5.9.30)$$

Substituting the values for the spontaneous magnetostriction, the final equation for the anisotropy energy measured at atmospheric pressure may be written as

$$\begin{aligned} U_a &= U^0_a + \tfrac{1}{2}V^0_{ij}S^*_{ij} \\ &= (K^0_{ij}+K'_{ij})n_in_j + (K^0_{ijk\ell}+K'_{ijk\ell})n_in_jn_kn_\ell \\ &\quad + (K^0_{ijk\ell mn}+K'_{ijk\ell mn})n_in_jn_kn_\ell n_mn_n + \ldots . \end{aligned} \qquad (1.5.9.31)$$

As an example, for the ferromagnets with a cubic prototype this equation may be written as

$$U_a = (K^0_1+K'_1)S(n_1^2n_2^2) + (K^0_2+K'_2)n_1^2n_2^2n_3^2. \qquad (1.5.9.32)$$

The coefficients K'_1 and K'_2 may be expressed in terms of the saturation magnetostriction constants $h_0,\ldots,h_5$ [see (1.5.9.12)] and the elastic stiffnesses $c_{\alpha\beta}$:

$$\begin{aligned} K'_1 &= c_{11}[h_0(2h_4-3h_3)+h_1(h_1-h_3+3h_4)-h_4(h_3-2h_4)] \\ &\quad + c_{12}[2h_0(2h_4-3h_3)-(h_1+h_4)(h_1+2h_3)] - \tfrac{1}{2}c_{44}h_2^2, \end{aligned} \qquad (1.5.9.33)$$

$$\begin{aligned} K'_2 &= -c_{11}[3h_4(h_1+h_3)+(h_4-h_3)(4h_4-3h_3)] \\ &\quad + c_{12}[3h_4(h_1+h_3)+h_3(5h_4-6h_3)] \\ &\quad - \tfrac{1}{2}c_{44}(6h_2+h_5)h_5. \end{aligned} \qquad (1.5.9.34)$$

For cubic crystals, K^0_i and K'_i are of the same magnitude. As an example, for Ni one has $K^0_1 = 80\,000$ erg cm^{-3} $= 8000$ J m^{-3} and $K'_1 = -139\,000$ erg cm^{-3} $= -13\,900$ J m^{-3}.

1.5.10. Transformation from Gaussian to SI units

Numerical values of magnetic quantities are given in Gaussian units in this chapter. For each quantity that appears in a table or figure, Table 1.5.10.1 gives the corresponding Gaussian unit and its value expressed in SI units. More details on the transformation between Gaussian and SI units are given *e.g.* in the Appendix of Jackson (1999).

1.5.11. Glossary

α_{ij}	(linear) magnetoelectric tensor
β_{ijk}	nonlinear magnetoelectric tensor *EHH*
γ_{ijk}	nonlinear magnetoelectric tensor *HEE*
Δ	Weiss constant
Δn	magnetic birefringence
ε_{ij}	dielectric permittivity
λ	constant describing magnetostriction
Λ_{ijk}	tensor describing the piezomagnetic effect
$\Lambda_{i\alpha}$	matrix describing the piezomagnetic effect
μ_{ij}	magnetic permeability
$\boldsymbol{\mu}$	magnetic moment
μ_B	Bohr magneton
$\pi_{ijk\ell}$	piezomagnetoelectric tensor
$\rho(\mathbf{r})$	charge density
Φ	thermodynamic potential
χ^e_{ij}	dielectric susceptibility
χ_{ij}, χ^m_{ij}	magnetic susceptibility
$\mathbf{B}$	magnetic induction
c	speed of light
$c_{ijk\ell}$	elastic stiffness
$\mathrm{d}\tau$	volume element
e	charge of the electron
$\mathbf{E}$	electric field
g	Landé g-factor
$\mathbf{H}$	magnetic field
$\mathbf{j}(\mathbf{r})$	current density
$\mathbf{J}$	total angular momentum
$\mathbf{k}$	position vector in reciprocal space
k_B	Boltzmann factor
$\mathbf{l}_i$	sum of the magnetic moments in a unit cell, in which some of the moments are taken with opposite sign
$\mathbf{L}_i$	antiferromagnetic vector
$\mathbf{L}$	orbital angular momentum (Section 1.5.1.1), antiferromagnetic vector (remainder of this chapter)
$\mathbf{m}(\mathbf{r})$	magnetic moment density
$\mathbf{m}$	sum of the magnetic moments in a unit cell
$\mathbf{M}$	magnetization (= magnetic moment per unit volume = ferromagnetic vector)
N	No. of atoms per unit volume
p	effective number of Bohr magnetons (Section 1.5.1), pressure (remainder of this chapter)
$\mathbf{P}$	electric polarization
$\mathbf{r}$	position vector in space
$\mathbf{S}(\mathbf{r})$	spin density
$\mathbf{S}$	spin angular momentum (of an atom or ion)
$s_{ijk\ell}$	elastic compliance
S_{ij}	strain tensor
T_{ij}	stress tensor
T	temperature
T_c	transition temperature, in particular Curie temperature
T_N	Néel temperature
U	energy
U_a	anisotropy energy
$U_{\rm el}$	elastic energy
$U_{\rm me}$	magnetoelastic energy
v	velocity
Z	atomic number (= number of electrons per atom)

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