

## Index

- activated state and equilibrium, 130  
activated state rate theory, 127  
activation analysis, 68  
activation energy, 61, 219, 227, 282  
activation entropy, 282  
activation volume, 219  
activity (chemical), 316  
adatom, 290  
adsorption, Gibbs excess, 316  
Ag, 300  
AISI 4140 steel, 388  
Al, 300, 308  
Al–Cu–(Mn,Sn), 376  
Al–Li, 198  
Al–Pb, 91  
allotriomorph, 91, 306, 376  
alloy phases, 21  
alumina, 308  
amorphous phase, 124, 302, 513  
    amorphization, 224, 243  
anharmonicity, 199, 218, 231  
anisotropy, 161, 207, 369, 439  
anisotropy energy, 562  
anisotropy gap energy, 553  
annealing, 335, 397  
anomalous diffusion, 13  
antibonding, 212  
antiferromagnetism, 534, 551  
antiphase domain boundary (APDB), 176, 258, 449  
antisymmetric wavefunction, 540  
aspect ratio, 414  
athermal, 491  
atomic ordering, 47  
Atomium, 507  
attempt frequency, 282  
Au, 300, 515, 517  
Au–Na, 55  
Au–Pb, 62  
Au–Pt, 519  
austenite, 122, 381, 385, 488  
austenitizing, 385  
autocatalytic, 380  
Avrami equation, 391  
 $b(k)$ , 469  
B2, 179, 478  
    second order, 474  
Ba, 324  
bainite, 122, 381, 388  
ball milling (high energy), 111  
ballistic jump, 275, 280  
band structure, 144, 151, 214, 521  
basis vector, 462  
BaTiO<sub>3</sub>, 560  
bcc, 461  
    2nn forces, 506  
Bessel function, 79  
binary alloy, 40  
binomial expansion, 41, 192, 283  
Bitter–Crum theorem, 416  
Bloch  $T^{3/2}$  law, 551  
Bloch wall, 530, 562  
Bloch's theorem, 142, 143, 549  
blocking temperature, 531  
Bogers–Burgers double shear, 493  
Boltzmann, 171  
Boltzmann factor, 16  
Boltzmann substitution, 71  
bond counting, 303  
bond energy, 139  
bond integral, 143  
bond proportion model, 189  
bond stiffness, 191  
    chemical effects, 199  
bond stiffness vs. bond length, 197  
bonding, 40, 133, 150, 212  
Born–von Kármán model, 191  
bosons, 175, 550  
boundary conditions, 73, 99, 146  
Bragg–Williams approximation, 49  
Brillouin function, 559  
Brillouin zone, 460  
bronze, 53  
bulk metallic glass, 243  
bulk modulus, 156, 207, 334  
Burgers vector, 483  
    conservation of, 486  
Cahn, John Werner, 407, 430  
Cahn–Hilliard equation, 429, 445  
calculus of variations, 431  
calorimetry, 183, 508  
carbide, 388  
carbon dioxide, 9

- carbon nanotubes, 521  
carbon steel, 385  
cast iron, 386  
casting, 343, 350, 353  
Cayley tree, 564  
Ce, 8, 9, 221  
cellular microstructure, 353  
cementite, 381  
charge density, 540  
chemical factor, 271  
chemical potential, 18, 268, 421  
chemical spinodal, 439  
chemisorption, 311  
chessboard, 180, 551, 592  
Clausius–Clapeyron equation, 211, 509  
cluster (of atoms), 95  
cluster expansion, 180, 200  
Co, 300  
coarsening, 378, 392, 456  
coherency strain, 375, 418  
coherent spinodal, 439  
coincidence boundary, 300  
collector plate, 376  
collision cascade, 112  
collisions, 96, 268  
colonies (pearlite), 382  
combinatorial factor, 200  
common tangent, 29, 403, 420  
complete the square, 249  
complex exponential, 462  
complex material, 228, 538  
complexion, 302  
composition fluctuation, 276, 424  
computer program, simulation, 233, 346, 414, 448  
concentration gradient, 435  
concentration profile, 119  
    moving, 349  
    stability of, 424  
concentration wave, 458  
    infinitesimal, 476, 478  
    stability, 479  
conductivity, 269  
configurational energy, 41  
configurational entropy, 41, 43, 54, 149, 489  
    glass transition, 337  
    nanostructure, 524  
configurational or dynamical coordinates, 171  
confined electrons, 520  
conservation of solute, 28, 67, 433  
conservative dynamics, 452  
conserved order, 444  
constitutional supercooling, 120, 349  
constrained equilibrium, 223  
constraint, 38, 433  
convection, 59, 369  
convex hull, 54  
convolution, 478  
cooling curve, 36  
cooling rate, 109  
Cooper pair, 4  
coordinate systems, 59, 78  
coordination number, 40  
core electron polarization, 542  
correlated electrons, 153  
correlation factor, 61, 282, 284  
    heterogeneous alloy, 256  
correlation factor (tracer), table, 255  
correlation function, 180  
correlation, entropy of liquid, 330  
Cottrell atmosphere, 226  
Coulomb energy, 63, 541  
covalency, 140  
Cr–Fe, 438  
critical condition, 205  
critical exponent, 173  
critical free energy of formation, 88  
critical nucleus, 85, 107  
critical point, 9, 318  
critical radius, 87, 88, 309, 364, 514  
    strain effects, 95  
critical temperature, 45, 51, 190, 194, 477, 547  
    change with  $\Delta S_{\text{vib}}$ , 190  
    displacive transition, 499  
    ordering, 196, 199  
    unmixing, 191, 194, 447  
critical temperature gradient, 351  
critical undercooling, 103  
critical wavevector, 436  
cry of tin, 488  
crystal field theory, 213  
crystal instability, 505  
crystallization, 124, 474  
crystallographic variant, 501  
CsCl, 462  
Cu, 300, 324  
Cu–Ag, 411  
Cu–Al, 489  
Cu–Co, 14, 85  
Cu–Zn, 489  
CuAu, Cu<sub>3</sub>Au, 462  
CuPt, 480  
Curie temperature, 381, 534, 545, 547, 559  
Curie–Weiss law, 548  
curvature, 296, 452, 455  
curvilinear coordinates, 454  
CuZr, 125, 337  
cylindrical coordinates, 78  
*d*-electrons, 213  
D0<sub>3</sub>, 462  
degrees of freedom, 37, 171, 192, 277  
    microstructure, 525  
dendrite, 120, 345, 353, 444  
    operating point, 365

- density functional theory, 153  
density of states, 144, 147, 550  
algorithm, 523  
deuterium, 270  
devitrification, 124  
diamond-anvil cell, 208  
diatomic molecule, 134  
diffusion, 12, 109, 113, 393, 435, 489  
anomalous, 13, 63  
assumptions, 64  
chemical potential, 393  
distance, 66, 72, 352  
ideal gases, 261  
inhomogeneous alloy, 260  
interface, 399  
liquid, 118  
marker velocity, 262  
zone, 308  
diffusion coefficient, 65, 260, 282  
diffusion equation, 66, 409  
paraboloidal coordinates, 366  
spherical coordinates, 354  
diffusionless transformation, 489  
dilatometry, 62  
dilute impurity, 56  
dimensionless integral, 550  
Dirac  $\delta$ -function, 69, 71  
Dirac notation, 134  
dislocation, 85, 294, 299, 339, 379, 482  
Burgers vector, 483  
core, 339, 484  
glide, 484  
groups of, 299  
partial, 486  
plastic deformation, 483  
reactions, 485  
self-energy, 484  
tilt boundary, 299  
disorder trapping, 411  
dispersion forces, 311  
displacement parameter, 501  
displacive ferroelectric, 537  
displacive instability, 496  
disproportionation, 243  
dissociation reaction, 485  
distribution coefficient, 115  
divergence, 454  
divergence theorem, 67  
domain, 176, 561  
domain boundary, 452  
DOS, 154, 523, 543  
driven systems, 275  
driving force, 128  
Dzyaloshinskii–Moriya int., 554  
easy axis, 231  
Edisonian testing, 5  
Ehrenfest's equations, 221  
eigenvectors, 505  
Einstein model, 191  
elastic anisotropy, 232, 439  
elastic energy, 93, 158, 207, 232, 412, 415, 437  
elastic field, 380  
elasticity, 159  
electric dipole moment, 559  
electrical conductivity, 151, 227, 269  
electron energy, 155  
dimensionality, 520  
electron gas, 145  
electron transfer, 141  
electron–phonon interaction, 227  
electron-to-atom ratio, 25, 154  
electronegativity, 25, 26, 199  
electronic DOS, 144, 150  
electronic entropy, 54, 148  
electronic heat capacity, 148  
electronic structure, 39  
embryo, 83  
emergent phenomenon, 4  
energy (see specific topic), 133  
energy landscape, 277, 335  
ensemble average, 252  
enthalpy, 54  
entropy (see specific topic), 171  
equation of state, 205  
equiaxed, 95, 343  
equilibrium  
kinetic, 126, 128  
nonthermodynamic, 275  
thermodynamic, 126  
equilibrium shape, 86  
error function, 72  
Eshelby cycle, 163  
Euler equation, 433, 449  
eutectic, 35, 57, 113  
eutectoid, 36, 381  
evaporation, 371  
exchange energy, 530, 539  
exchange hole, 541  
exchange interaction, 153, 546  
extensive variable, 229  
extreme conditions, 212  
extrinsic defect, 81  
fcc, 461  
Fe, 26, 226, 300, 542  
nanocrystal, 529  
Fe<sub>3</sub>Al, 462  
Fe<sub>3</sub>O<sub>4</sub>, 536  
Fe–C, 489  
Fe–Co, 544  
Fe–Cr, 15  
Fe–Cr–Si, 379  
Fe–Ni, 489, 491

- Fermi energy, 148  
Fermi surface, 151  
Fermi wavevector, 148  
Fermi–Dirac statistics, 475  
ferrimagnetism, 535  
ferrite, 381  
ferroelastic, 228  
ferroelectric, 228, 537, 559  
ferromagnetism, 228, 534, 545  
Fick's first law, 65  
first phase to form, 310  
first-order transition, 7  
fluctuation, 85, 424, 516  
    concentration, 436  
fluid, 59  
flux, 65, 68, 435  
force, 268  
forging, 385  
formation energy, 61  
Fourier series, 73  
Fourier transform, 436, 478  
Fourier–Bessel expansion, 79  
Fowler correction factor, 177  
fracture, 343  
Frank–Van der Merwe growth, 296  
free electron model, 146, 155  
free energy  
    alloy phases, 23  
    curvature, 46, 513  
     $k$ -space, 467  
    Gibbs, 16, 211  
    Helmholtz, 16, 192  
    Ising lattice, 44  
    phonon, 187  
    spinodal unmixing, 275  
    vs. composition, 27  
free volume, 335  
freezing, 6, 113, 321, 360  
Frenkel defect, 63  
Friedel, 340, 507  
frustration, 535  
functional, 432  
G–P zone, 373  
gases, 204, 318  
Gaussian, 100  
Gaussian integral, 100, 245, 278, 325  
generating function, 284  
Gibbs excess adsorption, 316  
Gibbs phase rule, 37, 443  
Gibbs, Josiah Willard, 95, 172  
Gibbs–Thomson effect, 93, 361, 515  
Ginzburg–Landau equation, 445  
glass, 122, 124  
    strong or fragile, 334, 336  
    transition, 124, 333  
Glauber mechanism, 444  
Gorsky effect, 226  
Gorsky–Bragg–Williams approximation, 49, 51, 195  
Grüneisen parameter, 197, 210, 220  
gradient, 238, 454  
gradient energy, 427, 429  
grain boundary, 89, 297, 301, 305, 377, 407, 524  
    allotriomorph, 91, 306  
    energy, 300  
    width, 512  
grain refinement, 411  
Green's function, 71  
 $H_2^+$  molecular ion, 140  
 $H_2$  molecule, 169  
habit plane, 482, 489  
hardenability, 388  
harmonic approximation, 189  
harmonic crystal, 247  
harmonic model, 186, 281  
harmonic oscillator, 187, 497  
Hartree–Fock wavefunction, 540  
Haucke phase, 422  
hcp, 509  
heat capacity, 173  
heat of formation, 27  
heat treating, 385  
Heckmann diagram, 228  
hedgehog skyrmion, 555  
Heisenberg model, 338, 539, 548  
Helmholtz free energy, 17  
Hessian matrix, 238, 505  
heterogeneous nucleation, 84, 379  
heteronuclear molecule, 140  
high-temperature limit, 189  
high-vacuum evaporation, 371  
homogeneous nucleation, 84  
homogeneous precipitate, 378  
Hooke's law, 160  
Hume–Rothery rules, 25  
Hund's rule, 542  
hydride, 236  
    metal alloy, 242, 421  
hydrogen, 13, 169, 186, 213, 311, 421  
hypereutectoid steel, 386  
hyperfine interaction, 4, 542  
hyperspace, 185, 278  
hypoeutectoid steel, 386  
hysteresis, 489  
ice, 220  
iced brine quenching, 111  
icosahedral structure, 517  
ideal gas, 204, 270, 371  
ideal solution, 44  
image force, 415  
imaginary frequency, 498  
incubation time, 103

- independent variables, 223  
indistinguishability, 330  
initial conditions, 73  
instability eigenvector, 238, 505  
insulator, 151  
integration by parts, 432  
intensive variable, 229  
interatomic potential, 156  
interchange energy, 42  
intercritical annealing, 389  
interdiffusion, 308  
interface, 399  
    atomistic, 403  
    concentration, 308  
    energy, 302, 430  
    growth rate, 344  
    internal, 379  
    solute partitioning, 402  
    velocity, 310, 343, 355, 402, 408, 454  
intergranular fracture, 343, 378  
internal friction, 226  
internal stress, 233  
interstitial, 13, 236, 320, 489  
interstitial mechanism, 60  
interstitialey mechanism, 13, 60  
intrinsic defect, 81  
Invar, 217, 231  
ion beam bombardment, 112  
ionic crystal, 63  
ionicity, 140, 141  
Ising lattice, 10, 191, 338, 525, 545  
    ordering, 194  
    variables, 546  
island growth, 296  
isoelectronic, 141  
isothermal, 491  
isotope, 186  
isotopic fractionation, 202  
isotropy, 161  
Ivantsov solution, 366
- jump rate, 64  
jump sequence, 254  
jumping beans, 283
- K, 156, 168, 324  
 $k$ -space, 146, 462  
 $k$ -vector quantum number, 143  
Kauzmann paradox, 334  
Kawasaki mechanism, 444  
KCl, 169  
kinetic energy, 139, 155, 244, 280  
kinetic master equation, 18, 126  
kinetic stability, 524  
kinetics, 128, 250  
kinetics and thermodynamics, 6  
kink, 290
- Kirkendall voids, 262  
Kopp–Neumann rule, 189  
Kosterlitz–Thouless transition, 339  
Kurdjumov–Sachs, 491
- $L_1$  structure, 462  
 $L_1$ , 480  
 $L_2$ , 462, 519  
    first order, 474  
laboratory frame, 262  
Lagrange multiplier, 433  
lamellar spacing, 384  
Landau theory, 446, 496  
    first order, 502  
    potential, 446, 502  
Landau–Lifshitz criterion, 473  
Langevin function, 558  
Langmuir isotherm, 311  
LaNi<sub>5</sub>–H, 243, 422  
Laplacian, 59, 238, 454  
    separable, 78  
laser processing, 111, 370  
latent heat, 7, 19, 321, 357, 383  
lattice gas, 316  
lattice mismatch, 85  
Laue condition, 461  
layer-by-layer growth, 296  
ledeburite, 381, 386  
ledge growth, 295  
ledges at surfaces, 289  
Lennard–Jones potential, 157, 168  
lenticular precipitate, 306  
lever rule, 27, 113  
    differential form, 116, 358  
levitation melting, 111  
Li, 330  
Lifshitz, Slyozov, Wagner, 395  
Lindemann rule, 333  
linear elasticity, 159  
linear oxidation, 308  
linear response, 128, 276  
linearize near  $T_c$ , 51, 196  
liquid, 6, 27, 206, 318, 329  
liquidus, 33, 57, 350  
local density approximation, 153  
local equilibrium, 31  
local nonequilibrium, 406  
local spins, 545  
long-range interactions, 477  
long-range order, 48, 195  
LRO parameter, 48, 546
- $M_f$  and  $M_s$ , 491  
magnetic entropy, 54  
magnetic field, 38  
magnetic flux, 561  
magnetic nanoparticles, 532

- magnetic order, 444  
magnetic phase transitions, 533  
magnetic susceptibility, 536, 552  
magnetism, 217, 529, 544  
magnetite, 535, 536  
magnetization, 509, 548  
magnetocrystalline anisotropy, 530  
magnetoelastic energy, 448  
magnon, 551  
many-body theory, 281  
marginal stability, 367  
marker velocity, 262  
martensite, 13, 381, 388, 482, 508  
    crystallography, 494  
    magnetic field effect, 538  
    transformation mechanism, 493  
master equation, 18, 126  
Maxwell construction, 206  
Maxwell relationship, 17, 212, 230  
mean field approximation, 51, 475, 552  
mean-squared displacement, 251  
mechanical attrition, 513  
melt spinning, 111  
melting, 6, 7, 220, 321, 474, 515  
    atom displacements, 332  
melting temperatures, table of, 322  
memory, 253  
Mendeleev number, 26  
metallic bond, 155  
metallic glass, 123  
metallic radius, 25, 26  
metastable, 290, 425  
methane, 311  
Mg, 26  
microsegregation, 120  
microstructure, 5, 122, 373, 392, 442,  
    511  
    entropy, 511  
    in steels, 386  
midrib, 490  
Miedema, A.R., 27  
migration energy, 61  
misfit energy, 415  
misfitting particle, 163, 417  
    ellipsoid, needle, plate, 167  
Mn, 155  
Mo, 324  
mobility, 128, 269, 453  
molecular dynamics, 283  
molecular orbital, 134  
molecular wavefunction, 137  
morphological instability, 353  
morphology, 95  
Morse potential, 157  
moving boundary, 348, 399, 410  
Mullins–Sekerka stability, 366  
multiferroic, 228  
Na, 156, 208  
Nabarro, Frank, 167  
nano-dots, 521  
nanomaterial, 511  
nanostructure, 93, 520  
    core–shell, 518  
    low-energy modes, 527  
    ordered domains, 519  
    phonon broadening, 529  
NaTl, 462  
Nb<sub>3</sub>Sn, 489  
Néel temperature, 552  
Nishiyama, 491  
NiTi, 508, 513  
nonconserved dynamics, 452  
nonconserved order, 444  
nonequilibrium cooling, 115  
normal coordinates, 186, 277  
normal modes, 185  
nose (TTT), 121  
nucleation, 14, 47, 95, 102, 121, 309, 319,  
    373, 426, 514  
    and growth, 14, 121, 373  
coherent, incoherent, 84  
edges and corners, 92  
elastic energy, 93  
grain boundary, 89  
heterogeneous, 84, 89  
homogeneous, 84  
in concentration gradient, 309  
multicomponent, 105  
steady-state, 97  
time-dependent, 103  
occupancy variable, 475  
Ohm's law, 269  
Olson–Cohen model, 493  
omega phase, 507  
Onsager Ising lattice, 173  
Onsager reciprocity relationships, 274  
optical phonon, 560  
orbitals, 213  
order parameter, 443, 464  
ordered domain, 176  
ordering, 47, 462  
orientation relationship, 491  
orthogonality  
    Bessel functions, 79  
    sine functions, 75  
    wavefunctions, 134  
overcounting, 40  
oxidation, 306  
oxygen, 68, 213  
pair approximation, 176  
    consistency, 176  
    potentials, 42

- parabolic oxidation, 308  
paraelectric, 537  
paramagnetism, 534  
parent phase, 86  
partial differential equation, 73  
partial dislocation, 486  
particle in a box, 146  
partition function, 15, 187  
    configurational, 40, 191  
    harmonic oscillator, 187  
    ordering, 196  
partitioning ratio, 115, 349, 403, 408  
    nonequilibrium, 398  
partitionless phase formation, 403  
passivation of surface, 308  
Pd, 300  
Pd–V, 198  
Péclet number, 362  
pearlite, 122, 380  
peptide, 517  
percolation threshold, 455  
periodic boundary condition, 143, 549  
periodic minimal surface, 455, 456  
peritectic, 35  
peritectoid, 36  
perovskite, 560  
Pettifor, David, 26  
phase diagram, chemical  
     $T$ – $c$ , 10  
    continuous solid solubility, 32  
    eutectic, 34, 36  
    peritectic, 34, 36  
    unmixing, 46, 447  
phase factor, 142, 524  
phase field theory, 346, 441  
phase space, 329  
phase stability, 21  
phase transition, 11  
    vs. transformation, 12, 389  
phase, definition, 442  
phonon  
    damping, 529  
    density of states, 188  
    entropy, 187  
    thermodynamics, 175  
physical vapor deposition, 111  
physisorption, 311  
pinning, 226  
pipe diffusion, 379  
piston-anvil quenching, 111  
Planck distribution, 187  
plastic deformation, 233, 488  
plate precipitate, 412  
PMN, 537  
point approximation, 47, 475, 552  
polariton, 561  
polaron, 63, 226  
pole mechanism, 487  
polycrystalline material, 525  
polymer, 141  
position-sensitive atom probe, 14  
positron annihilation, 260  
potential energy, 139, 244, 279  
    gradient, 268  
Potts model, 338  
precipitate, 84, 114  
    ellipsoidal, 93, 167  
    growth, 114  
    lens shape, 95  
    needle, 167  
    shape, 412  
    strain effects, 93  
precipitate-free zone, 378  
premelting, 319  
pressure, 9, 18, 92, 155, 204  
    thermal, 210  
primitive lattice translation vector, 460  
probability, 16  
processing of materials, 5  
proeutectoid ferrite, 386  
projection, 134  
prototype structures, 462  
Pt, 300, 517  
Pt–Fe, 519  
PZT, 537  
quadratic formula, 503  
quantum dot structures, 297  
quantum level separation, 146  
quantum mechanics, 134  
quantum volume, 312, 329  
quartic, 502  
quasiharmonic model, 202, 211, 231, 325  
quasiparticle, 247, 556  
quasistatic, 283  
quench, 84  
radiotracer, 68  
random solid solution, 40  
random walk, 101, 251  
rare earth metals, 169  
reaction coordinates, 335  
recalcescence, 321  
reciprocal lattice, 460  
reconstruction (surface), 289  
relativistic self energy, 488  
relaxation (surface), 289  
relaxor ferroelectric, 537  
Richard's rule, 108, 331, 337  
Riemann zeta function, 550  
rigid band model, 154  
roots of Bessel function, 79  
Rose equation of state, 323  
roughening transition, 292

- Sackur–Tetrode equation, 330  
saddle point, 238, 278, 336, 455, 470  
scaling of interatomic potential, 323  
Scheil equation, 117, 358  
Schottky defect, 63  
Schrödinger equation, 133  
Schwarz P-surface, 455, 456  
Schwarz–Khachaturyan model, 421  
second-order phase transition, 473, 501  
self-similar, 394, 512  
semiconductor, 151  
separability, 223  
separation of variables, 73  
sextic, 502  
shape fluctuation, 517  
shape memory alloy, 508  
shear transformation, 491  
shock wave processing, 111  
Shockley partial dislocation, 486, 487  
short-range order, 176  
shuffle, 494  
Si, 13, 62, 290, 310, 330  
Simmons–Balluffi experiment, 62  
singularity, 3, 173  
SiO<sub>2</sub>, 334  
size fluctuation, 517  
skyrmion, 555  
Slater–Pauling curve, 544  
Sm, 324  
smart material, 228  
Snoek effect, 226  
social network, 564  
soft mode, 505, 507  
solid mechanics, 159  
solid solution, 10, 24, 40, 415  
solid-on-solid model, 292  
solid-state amorphization, 224, 243  
solidification, 6, 342, 360, 443  
solidus, 33, 57, 350  
solute conservation, 28, 195, 545  
solute drag, 226, 273, 407  
solute partitioning, 123, 348  
nonequilibrium, 398  
solute trapping, 406  
solvability theory, 369  
Space Shuttle, 367  
special points, 466, 470  
sphere, misfitting, 164  
spherodite, 381, 389  
spin, 180  
spin wave, 534, 548, 553  
spin–orbit coupling, 554  
spinodal decomposition, 15, 45, 194, 275, 424, 469  
spinodal ordering, 52  
spiral growth, 295  
splat quenching, 111  
spring, 162, 207  
sputtering, 68, 111  
square gradient energy, 15, 303  
square lattice, 48, 194, 523  
stabilization of austenite, 492  
stacking fault, 485, 518  
energy, 486  
star of wavevector, 465  
state variable, 15, 126, 223  
static concentration wave, 458  
statistical kinetics, 250  
steady state, 98  
steel, 226, 380, 386, 489  
Stirling approximation, 41, 175, 177, 192, 526  
Stoner criterion, 543  
strain, 159  
strain field, 448  
Stranski–Krastanov growth, 297  
strength, 388  
stress, 160  
stress-free strain, 413  
structure factor rules, 461  
structure map, 26  
structure of solids, 5  
structure–property relation, 5, 181  
sublattice, 48, 194, 236  
substrate mismatch, 297  
succinonitrile, 367  
superconductor, 4  
superferromagnetism, 531  
superheating, 8, 121  
superparamagnetism, 531  
supersaturation, 84  
surface energy, 15, 86, 120, 168, 297, 303, 353, 412, 514  
chemical contribution, 302  
surface growth, 294  
surface reactions, 306  
symmetry, 6, 501  
operations, 464  
temperature gradient, 272  
tempering, 388  
tensor, 161, 231  
ternary phase diagram, 37  
terrace, 290  
Th, 330  
thermal arrest, 36  
thermal conductivity, 110  
thermal de Broglie wavelength, 329  
thermal expansion, 62, 231, 325  
thermal noise, 369  
thermal pressure, 210  
thermodynamic fluctuation, 516  
thermodynamic identity, 17, 230  
thin film, 371  
growth, 296  
reactions, 307, 310

- Ti, 506  
Ti–Nb, 489  
tie-lines, 38  
tight binding, 143, 521  
time–temperature–transformation diagram, 121, 387  
topological protection, 555  
toughness, 388  
tracer, 68, 254  
transient structure, 93  
transition metal, 154, 543  
transition metal silicides, 310  
transition rate, 126  
translational symmetry, 141, 471  
transmission electron microscope, 519  
twinning, 482, 492, 509, 518  
two-level system, 216  
two-sublattice model, 236  
  
undercooling, 121, 364, 411  
unit cell, 462  
universal potential curve, 323  
unmixing, 236, 424, 446, 469  
  
 $V_3Si$ , 489  
vacancy, 254, 290  
concentration, 56, 260  
diffusion, 59  
mechanism, 13, 60, 444  
pump, 374  
trap, 258, 284  
Van der Waals, 153, 205, 311  
Van Hove singularity, 523, 527  
vapor pressure, 371  
  
variational calculus, 431  
Vegard’s law, 416  
velocity transition, 411  
Verwey transition, 536  
vibrational entropy, 282  
concept, 184  
glass transition, 337  
vicinal surface, 299, 304, 315  
Vineyard theory, 277  
viscosity, 334  
Volmer–Weber growth, 95, 296  
vortex skyrmion, 555  
  
W, 300  
W-matrix, 126  
Walser–Bené rule, 311  
water, 9  
waves in crystals, 459, 462  
Weiss theory, 217  
Wigner–Seitz radius, 333  
Wulff construction, 305  
  
X-ray diffraction, 62, 462  
X-ray imaging, 367  
*x*–*y* model, 338  
  
yield point, 226  
  
Zeldovich factor, 97, 100  
Zener ratio, 161, 439  
zero-point energy, 202  
zone refining, 130  
Zr, 507  
amorphous alloys, 243