

- : stress-induced directional ordering, 1782 ff
- : structure, 1769 ff
- : superconductivity,
- : thermodynamics, 1728
- : T_c , 1744
- , transition-metal-based, 1736
- : viscosity, 1798 ff
- : wires, 1751, 1800
- Amorphous media, plastic deformation, 1950 ff
- Amorphous powders, sintering, 2638 ff
- Amplification factor, 1491
- Analytical electron microscopy, *see* "Transmission electron microscopy"
- Andrade creep, 1934 ff, 1961 ff
- Anelasticity, *see* "Elasticity and Anelasticity"
- Anisotropy energy
 - , magnetocrystalline, 2505, 2509
- Anneal-hardening, 2410
- Annealing**
 - (of) polymers, 2671
 - textures, 2455 ff
 - : cube texture, 2459 ff
 - , effect of prior recovery on, 2418
 - : mesotextures, *see* "Mesotextures"
 - : microgrowth selection, 2458
 - : oriented growth hypothesis, 2458
 - : oriented nucleation hypothesis, 2457 ff
 - : orientation distribution function, 2456
 - : origin, 2457 ff
 - : pole figures, 2456 ff
 - in two-phase alloys, 2466
 - twin formation, 897, 2477 ff
- Anomalous flow behavior in $L1_2$ phases, 2085 ff, 2195 ff
 - : models, 2089 ff
- Antiferromagnetism, 123 ff, 1125, 2503
- Antimony
 - crystal structure, 25 ff, 37
- Antiphase domains, 193, 256
 - size, effect on strength, 2061
 - , boundaries, 1852, 2056, 2061, 2081 ff, 2086 ff
 - , growth, 871
- Antistructure atoms, 600
- Apparent atomic diameter, 159
- Approximants, 373, 379 ff
- Arsenic
 - crystal structure 25 ff, 37
- Ashby maps, 1268 ff, 1887, 1958 ff, 2001, 2002, 2379
- Atom-probe field-ion microscopy, 1218
- Atomic energy levels, 51 ff
- Atomic-force microscopy, *see* "Microscopy"
- Atomic form factor, 1103
- Atomic orbitals, *see* "Orbitals"
- Atomic radius, 56 ff
 - as affected by magnetism, 122 ff, 127
 - Ashcroft empty-core, 77, 88 ff
 - , listing for elements (12-coordination), 329
 - , Wigner-Seitz, 49, 76, 86 ff
 - , Zunger (pseudopotential), 58
- Atomic size, 56 ff
 - factor, 144
 - in elements, 157,
 - in intermetallic compounds, 327 ff
 - : near-neighbors diagram, 334 ff
 - in solid solutions, 154 ff
 - , measurement, 165 ff
- Atomic sphere approximation, 79, 85
- Atomic volume
 - , in solid solutions, 159 ff
 - , in intermetallic compounds, 327 ff (*see also* "Atomic radius" and "Atomic size")
- Atomization, 820
- Au_3Cu structure, alternative descriptions, 241 ff
- Auger-electron microscopy, 986 ff
- Auger-electron spectroscopy, 989, 1212
- Austenitic steel, 1568, 1610 ff
- Average group number, 154
- Avrami equation, *see*
 - Johnson-Mehl-Avrami-[Kolmogorov] kinetic equation
- Axial ratio, 137, 174

- B**ainite, bainitic transformation, 1408, 1468 ff, 1544, 1576 ff
 - : carbon supersaturation in bainite plates, 1473 ff, 1476
 - : crystallography, 1472 ff
 - : displacive or reconstructive?, 1469 ff
 - : grain-size effect, 1473
 - in non-ferrous alloys, 1471
 - : kinetics, 1474 ff
 - : partial transformation, 1476 ff
 - : surface relief, 1472
 - : theory, current status, 1478 ff
- Ball-milling, 914, 1766 ff
- Band formation, 63 ff
- Band structure, 69 ff
- Band theory, 64 ff
 - : breakdown at large lattice spacings, 81 ff
 - of magnetic properties,
 - : volume dependence, 72 ff, 84 ff

- Barkhausen noise, 2559
 Barium
 -: polymorphism, 18, 20
 Bauschinger effect, 1935 ff
 -- in polycrystals, 1937
 -- in single crystals, 1936
 -- in two-phase alloys, 2113 ff
 Bend-gliding, 2410
 Berthollides, 206
 Beryllium
 -: bonding type, 18
 Bilby–Cottrell–Swinden (BCS) model, *see*
 “Cracks”
 Binary intermetallic phases, 102 ff
 -: heats of formation, calculation, 111 ff
 Bismuth
 - crystal structure, 25 ff, 37
 Bohr model of atom, 52 ff
 Bohr radius, 57
 Bloch law, 2549
 Bloch's theorem, 67
 Body-centred cubic structure
 -, derivative structures, 273 ff
 -, dislocation structure in, 1845
 Boltzmann's entropy equation, 435
 Bond
 - chemical, 3
 - covalent, 3 ff
 - formation, 59 ff
 - ionic, 3
 - metallic, 4 ff
 Bonding and antibonding states, 60, 62
 Bordoni peak, 1857
 Born–Mayer potential, 1624
 Boron in steels, segregation, 1245 ff
 Bragg's law, 1102
 Brass, beta-, 168 ff
 Brass, gamma-, 170
 Bravais lattices, 14
 Bridgman crystal growth method, 719
 Brillouin zone, 67 ff, 151
 - in hexagonal electron phases, 171 ff
 - in ordered structures; 196 ff
 Bulk properties of metals
 -, electron theory, 87 ff
 Burgers vector, *see* “Dislocations”
- C**aCu₅ structure, 281 ff
 Cadmium
 - crystal structure, 22
 Calphad, 495 ff, 516 ff
 Carbides of iron, 1563 ff
 Carbon in iron, 1561 ff
 Cast irons, 771, 1616 ff
 -: eutectic morphology, 817 ff
 -, growth of graphite in, 817 ff
 -, modification, 816 ff, 1618
 -, spheroidal (nodular), 817, 1616 ff
 -, white, 1616
 Cast structure, *see* “Ingot structure”
 Casting
 -, continuous, 797 ff, 1599
 -: flowability, 797
 -: fluidity, 795 ff
 -: grain refinement, 810 ff
 -: mouldless electromagnetic, 803
 -: rheocasting, 829
 -: semisolid metal forming processes, 826 ff
 - (of) steels, 1615 ff
 -: stir-casting of metal-matrix composites, 2570
 -: thixocasting, 829
 Cathodoluminescence, 971
 Cavitation in creep, 1253, 1263 ff
 Cell formation and properties, *see* “Dislocations”
 and “Recovery from Deformation”
 Cemented carbides
 -, nanostructured, 928
 -, sintering, 2652 ff
 Cementite, 156
 Cerium
 -: polymorphism, 31 ff, 39, 43
 -: pressure dependence of structure, 43
 Cesium
 -: polymorphism, 17
 -: pressure dependence of structure, 19
 Chalcogenides, 36
 Characterization of materials, generalities, 996
 -, geometrical, 997
 Charge density waves, 1548 ff
 - and incommensurate phases, 1549
 Charpy test, 2280
 Chemical diffusion, 607 ff
 Chemical potential, 416
 Chemically induced boundary migration, *see*
 “Diffusion-induced grain-boundary migration”
 Chromium
 -: antiferromagnetic phase transitions, 20
 Chromium–oxygen–sulphur system, 1313, 1316
 Clapeyron equation, 423
 Clausius–Clapeyron equation, 423
 Climb, *see* “Dislocations” and “Creep”
 Close packing, 7 ff, 16, 98 ff

- Coarsening
 - , competitive, 1437 (*see also* "Ostwald ripening")
 - , discontinuous, 1458 ff
 - of eutectoids, 1458 ff
- Coating technology, *see* "Protective coating technology"
- Cobalt–rare earth magnets, 2519 ff
- Cobalt–silicon alloys, 1458 ff
- Coble creep mechanism, 1269 ff
- Coffin–Manson law, 2295, 2303
- Coherent and incoherent interfaces, 2107 ff
- Coherency loss, 2144
- Cohesive energy, 84 ff, 89, 148, 152
- Coincidence site lattice, 844 ff, 1075
- Cold-working,
 - , enhancement of diffusion by, 634 ff
- Combustion, corrosion problems, 1292 ff
- Common tangent rule, 475, 511
- Competitive coarsening, *see* "Ostwald ripening"
- Composite materials (metal-matrix)**, 2567 ff
 - : aluminum–silicon carbide, 2572 ff, 2585 ff, 2591
 - : alumina fibers (Saffil), 2569
 - : chemical reaction at fiber-matrix interface, 2579 ff
 - : creep, 2183, 2611 ff
 - , thermal-cycling enhanced, 2612 ff
 - : definition, 2568
 - : deformation behavior, 2581 ff
 - : fatigue, 2606 ff
 - : fracture, 2596 ff, 2604 ff
 - at high temperature, 2611 ff
 - : inhomogeneity of flow, 2587
 - : macroscopic yielding, 2587
 - : matrix flow, 2584 ff
 - : misfit strains from differential thermal contraction, 2584, 2589 ff
 - : tension-compression asymmetry, 2591
 - : strain hardening, 2592 ff
 - : stress relaxation, 2594
 - : ductility, 2597 ff, 2601 ff
 - as function of dispersoid fraction, 2602
 - : elastic properties, 2581 ff
 - : differential Poisson contraction, 2588
 - : effect of fiber aspect ratio, 2584
 - : matrix stresses analysed by Eshelby model, 2581 ff, 2592
 - , prediction, 2581 ff
 - , prediction compared with experiment, 2583
 - , fiber-reinforced, 2568 ff
- , in-situ grown, 774 ff,
- : interfacial debonding and sliding, 2594, 2598
- : interfacial bond strength, 2598
- : matrix cavitation, 2598 ff
 - , critical hydrostatic stress, 2598
- : mechanical properties, *see* "deformation behavior"
- : misfit strains, *see* "deformation behavior"
- : particle pushing, 2572
- : particle-reinforced, 2568, 2570
- : plastic deformation, *see* "deformation behavior"
- : processing, liquid-phase, 2569 ff
 - : directional oxidation, 2577
 - : Osprey processes, 2574
 - : preforms, binder, 2570
 - : reactive processing, 2576 ff
 - : solidification, 824
 - : spray deposition, 2574 ff
 - : squeeze infiltration, 2569 ff
 - : stir casting, 2571
- : processing, solid-state, 2577 ff
 - : bands, ceramic-rich, 2578
 - : diffusion-bonding of foils, 2579 ff
 - : extrusion, 2577
 - : hot isostatic pressing, 2579
 - : physical vapor deposition, 2581
 - : plastic forming, 2579
- : silicon carbide monofilament, 2568, 2615
- : stress-strain curves, 2603
- : thermal cycling effects, 2612 ff
- : thermal expansion, 2609 ff
- : thermal stresses, 2609 ff
- : titanium-matrix composites, 2580, 2586, 2600, 2614 ff
- : void formation, 2575, 2598 ff
- : wear resistance, 2595 ff
 - , dependence on fiber content, 2596
- : whiskers, 2570
- Compositional superlattice, 902 ff
- Compounds
 - , intermetallic, *see* "Intermetallic compounds"
- Compton scattering, 1126
- Congruently melting compounds, 347
- Conodes, 473
- Considère's criterion, 2694 ff
- Constitutional
 - supercooling, 721, 724
 - vacancies, 186 ff
- Continuous annealing lines, 1602

- Continuous ordering, 1370, 1490 ff
 -: amplification factor, 1491
- Continuous casting, *see* "Casting"
- Continuum mechanics and dislocation mechanics,
 1947 ff, 2001 ff
 -: effective strain rate, 2003 ff
 -: evolution of deformation resistance, 2003 ff
 - (and) internal stress, 2128 ff
 - (and approach to) multiphase materials,
 2182 ff
 --: creep, 2183
 --: rafting, 2182
 -, polymers, 2694 ff
 -: representative volume element, 2001
- Cooling rates in rapid solidification processing,
 1752 ff
 -: direct measurement methods, 1753 ff
 -: estimates based on microstructural features
 (indirect methods), 1753
- Coordination number, 10 ff, 339 ff
- Coordination polyhedra, 6 ff, 341
- Copper alloys
 -: dispersion hardening, 2112
 -: solid-solution hardening, 2026
- Copper-aluminum alloys, 1152 ff, 1468, 2014,
 2344, 2347 ff
- Copper-beryllium alloys, 1156
- Copper-cobalt alloys, 1390 ff, 1421, 1440
 -, precipitation hardening, 2051 ff
- Copper, explosively deformed, 2406
- Copper-gold alloys, 195 ff, 1133, 1150 ff, 1187,
 1544 ff, 2058
- Copper group metals
 -: crystal structures, 21 ff
- Copper-manganese alloys, 1160
- Copper-nickel alloys, 2026
- Copper-nickel-chromium alloys, 1490 ff
- Copper: recovery from deformation...is it
 possible?, 2402 ff
- Copper-silicon alloys, 1418, 2026
- Copper-titanium alloys, 1392, 1489, 1493
 -, spinodal decomposition, 2055
- Copper-zinc alloys, 1157 ff, 1161, 1409, 1426,
 1468, 2029, 2064, 2078 ff, 2112, 2353
- Correlation energy, 88
- Corrosion, hot, of metallic materials**, 1292 ff
 -: extreme, modelling of, 1340 ff
 - (by) hot salt, 1317 ff
 --: fluxing theory, 1320 ff
 --: coal-fired gas turbines, 1323 ff
 --: measurement, 1337 ff
 --: pseudo-scale theory, 1323
 -: sodium sulphate, 1319 ff
 -: vanadate-induced attack, 1323
 - (by) solid deposits, 1338
 -: test and measurement methods, 1325 ff,
 1337 ff
- Cottrell atmosphere, 1867 ff, 1970, 2041 ff
- Cottrell method of analysing fatigue hysteresis
 loops, 2314
- Cottrell-Stokes law, 1915
- Covalency, 61 ff
- Covalency, degree of, 61
- Crack(s)**, (*see also* "Fracture")
 -: atomic structure, 2245 ff
 --: bond forces, 2249
 --: force law problem, 2247
 --, modelling, 2245 ff
 -, atomically sharp, 2216
 -: BCS model, 2239 ff
 -: brittle crack initiation, 2277
 -: chemical environment effects, 2265
 -: continuum crack and "lattice crack"
 compared, 2248 ff, 2253
 -: crack opening displacement, 2234
 - (and) dislocations compared, 2208 ff
 -- crack equivalent to a pile-up of
 prismatic dislocations, 2231
 -: dislocation emission, 2254 ff
 --: emission criteria, 2255 ff, 2260 ff
 --: Rice criterion, 2258
 --: Rice-Thomson criterion, 2256
 --: ZCT criterion, 2258
 -: dislocation-crack interaction, 2217 ff,
 2231 ff, 2235 ff
 -: ductility crossover criterion, 2258
 -: energy release rate, 2225, 2229
 -: equilibrium configurations of cracks and
 dislocations, 2235 ff
 -: Eshelby's theorem, 2225 ff
 -: extension force, 2225, 2229
 -: fatigue crack initiation
 -- in ductile metals, 2362 ff
 -- (at) grain boundaries, 2372 ff
 -: fatigue crack propagation, 2376 ff
 -: Griffith criterion (condition) for crack
 stability, 2236 ff,
 --: mixed mode effects, 2262 ff
 -- for continuum and lattice models
 compared, 2252 ff
 --: thermodynamic condition, 2254
 -: HRR (Hutchinson, Rice and Rosengren)
 crack-tip field, 2242 ff
 -: initiation, *see* "brittle crack initiation"

- , interfacial, 2265 ff
- : *J*-integral, 2225 ff, 2229 ff, 2243
- : lattice trapping, 2248 ff
- : oscillatory crack closure, 2267
- : precipitate pinning,
- : (general) shielding, 2238 ff
- : slow crack growth, 2248 ff, 2251
- : strain energy density function, 2221
- : stress analysis, 2220 ff
- : stress-shielding (screening) dislocations, 2233, 2237 ff
 - : antiscreening dislocations, 2235
- (as) stress concentrator, 2209
- stressing modes, 2212 ff, 2223 ff, 2380
- stress intensity, 2268
- : stress intensity factors, 2222 ff
- tip stress singularity, 2222
- velocity, 2248 ff
- Creep**, 1958 ff
 - : amorphous alloys, 1797 ff
 - , Andrade, 1934 ff, 1961 ff
 - cavitation, 1253, 1263 ff
 - : (dislocation) climb models, 2186 ff
 - , Coble, 1269 ff
 - : crossover temperature, 2169 ff
 - , diffusion-, *see* "Nabarro–Herring–Coble"
 - : diffusion-compensated creep rate, 2186
 - : dislocation cell structure, 1839, 1922, 1930
 - : dispersed-phase alloys, 2134 ff, 2154 ff
 - : mechanisms, 2155
 - embrittlement by impurities, 1275 ff
 - , grain-boundary sliding during, 1993 ff
 - compared with gliding in grains, 1995
 - , spurt-like, 1996
 - : grain-size effects, 2168 ff
 - : Harper–Dorn creep, 1973
 - , high-temperature, 1958 ff
 - , impression, 1961
 - , inverse, 2196
 - , irradiation-induced, 1700 ff
 - , logarithmic, 1934 ff
 - , low-temperature, 1933 ff
 - : microcreep, 2023
 - : minimum creep rate, 1964
 - (of) metal-matrix composites, 2611 ff
 - , Nabarro–Herring–(Coble), 1988 ff
 - as a process of material transport, 1994
 - : changeover from Coble creep to Nabarro–Herring creep, 1991 ff
 - in sintering, 2636
 - not affected by diffusion, 1934, 1958
 - of ordered alloys, 2064 ff, 2078, 2080
 - of oxide-dispersion-strengthened alloys, 2184
 - , power-law, 1960 ff, 2646
 - breakdown range, 1969, 1999
 - : precipitation-hardenened alloys,
 - , primary, 1960, 1963, 1967
 - , rate
 - : dependence on grain size, 1991 ff
 - : dependence on stacking-fault energy, 1964 ff, 1986 ff
 - : dependence on stress, 1964 ff
 - : dependence on time and temperature linked, 1968
 - : Dorn equation, 1964
 - : functional form, 1961 ff
 - : creep–rupture ductility (life)
 - : effect of grain-boundaries, 1263 ff
 - : (of) solid solutions, 1969 ff, 1990 ff, 2039 ff
 - : critical dislocation velocity, 1971
 - (controlled by) cross-slip, 2042 ff
 - , processes in, 1977 ff
 - : solute drag, 1970 ff, 2040 ff
 - , steady-state (secondary), 1960
 - through dislocation climb, 2040 ff
 - , processes in, 1977 ff
 - , subgrain(s)
 - , dislocation densities in, 1985
 - migration, 1982
 - misorientations, 1983
 - tertiary, 1960
 - : thermal recovery, static, balancing strain-hardening, 1973 ff
 - : threshold stress, 2185 ff
 - , transient changes
 - , at low temperatures, 1933 ff
 - after a stress drop during steady-state creep, 1987
 - Critical resolved shear stress for glide**, 1885 ff, 1926, 2024
 - , concentration dependence in solid solutions, 2024 ff
 - , ionic crystals, 2038 ff
 - Crowdion**, 537
 - Crystal growth**
 - , single, 809 ff
 - , Bridgman method, 810
 - , Czochralski method, 810
 - , floating-zone method, 810
 - Crystal structure**, *see* "Structure"
 - Curie law**, 2502
 - Curie temperature**, 2503, 2509
 - Curie–Weiss law**, 2504

- D**arken–Gurry plot, 161
 Darken's equations, 609 ff
 Daltonides, 206
 Dauphiné twin in quartz, 868
 Debye–Waller factor, 1104
 –, “static”, 1133
 Decagonal symmetry, 378, 382 ff
 Defect structures, 186 ff
Deformation
 – bands, 2427 ff, 2431 ff (*see also* “Transition bands”)
 –, cyclic, 2336 ff
 – mechanism, in iron, 1584 ff
 – mechanism maps, 1268 ff, 1887, 1958 ff,
 2001, 2002, 2379
 – (of) polymers, 2692 ff
 – textures, evolution, 1943 ff
 ––: Taylor model, 1943
 –: twinning, *see* “Twinning”
Dendrite
 –: cell-to-dendrite transition, 748 ff
 –: formation in solids, 1421 ff
 –: microsegregation around dendrites, *see*
 “segregation”, below
 –: primary arm spacing, 741 ff
 ––, comparison with cell spacings, 745
 –: secondary arm spacing, 746 ff
 –: segregation, 749 ff
 –– and solid-state diffusion, 752
 – tip radius, 732 ff, 1429 ff
Dendritic growth, 731 ff, 739 ff
 –, anisotropy, 737 ff, 742
 –: branches, 746, 1430
 –: coarsening, 746 ff
 –: computer modelling, 755
 – in eutectics, 765
 –: instability in solids, 1421 ff
 ––: dendritic growth in solids and in
 liquids compared, 1425
 –: examination of nonmetals, 739
 –: interdendritic fluid flow, 789 ff
 –: theories, new, 755
 – velocity, 736 ff, 751, 813
 – with peritectic solidification, 776 ff
Density of (electron energy) states, 66, 74 ff
 –; transition metals, 83 ff
Diamond structure, 4, 6, 11, 25, 99, 283 ff
 –, hardening, 2038 ff
 –, nanocrystalline, 920
 –, the ultimate polymer, 2700
Diatomique molecule
 –, heteronuclear, 61
 –, homonuclear, 61
 Differential scanning calorimetry, 1786 ff, 1790,
 2401 ff, 2722 ff
Diffraction theory
 –, dynamical, 1044 ff, 1082 ff
 –, kinematical, 1094 ff
Diffuse scattering of radiation, 1118 ff, 1134 ff,
 1139 ff, 1145, 1148 ff
Diffusion, 536 ff
 –: activation volume, 558
 –: amorphous alloys, 643 ff, 1731 ff, 1778 ff,
 1804 ff
 –, anomalous, 573
 –: Arrhenius behavior, 1661 ff
 –, chemical, 541 ff, 607 ff
 –– in ternary alloys, 611
 – coefficient, *see* “Diffusion coefficient”
 –, collisional, *see* “Ion-beam mixing”
 –: complex mechanisms, *see* “Fast diffusion”
 –: concentrated alloys, 595 ff
 –, correlation effects, 548, 550 ff, 598, 621
 –: correlation factor, 543, 550, 591
 – creep, 1268 ff, 1988 ff
 –: critical slowing down, 610
 –, Darken's equation s, 609 ff
 – dilute alloys, 542 ff, 582 ff
 ––: diffusion in terms of jump frequencies,
 584
 ––: linear response method, 586 ff
 ––: solute diffusivity as a function of
 solute concentration, 588
 ––: solute and solvent diffusivities, ratio,
 591 ff, 594
 ––: standard model, 583
 –, dislocation-, 621
 –: divacancies, role of, 538, 579, 591
 –: Einstein relation, 546
 –: electromigration, 612 ff, 616 ff
 –: exchange mechanism, 536
 –, extrinsic temperature region, 558
 –: (anomalously) fast diffusion, 593 ff, 1187,
 1746, 1807 ff
 –: Fick's first law, 542
 –: Fick's second law, 545
 ––, limitations of, 552
 –, grain-boundary, 620, 623 ff
 ––, atomic model, 624 ff
 ––: effect of impurity segregation, 1255 ff
 ––: role in diffusion creep, 1268 ff
 –: interstitial diffusion, 592 ff
 –: interstitial mechanism, 537
 ––: dumbbell mechanism, 592 ff
 ––: Zener formula, 582
 –: intrinsic diffusion region, 558

- , irradiation-enhanced, 635 ff
- : isotope effect, 558 ff
 - , reversed, 594
- : jump frequency, 547 ff
- : Kirkendall effect, 608 ff, 1625
- : macroscopic theory, 539 ff
- : Manning's random alloy model, 596 ff
- : Matano plane, 546
- : mechanisms, 536 ff
- : mixed mechanisms, 538
- : molecular dynamics approach, 560
- : Monte Carlo method, 561, 597
- : Nernst-Einstein relation, 550
- : non-equilibrium defect concentrations, effect of, 633 ff
- : numerical simulation, 559 ff
- : ordered (long-range) alloys, 599 ff
 - , with B2 structure, 602 ff
 - , with L1₂ structure, 604 ff
 - , with other structures, 606 ff
 - : use of spectroscopic methods, 601
 - : six-jump cycle model, 601
 - , variation with temperature for CuZn, 2079
- : pipe-diffusion, 619 ff, 621 ff
- : pressure effects, 558
- : quenched-in vacancies, effect of, 633 ff
- , radiation-enhanced, 638 ff
- , random-walk theory, 546 ff
- , self-, 572 ff
 - , prediction, 581 ff
 - , empirical relationships, 582
- , short-circuit, 539, 619 ff
 - : short-circuit networks, 622
- : short-range order, effect of, 598
- : solute-vacancy binding energy, 592
- , surface, 626 ff
 - : experimental results, 630 ff
 - : effect of contaminants, 632, 1254
- : Thermomigration, 611 ff, 615
- : vacancy mechanisms, 538 ff
 - , relaxation mechanism, 538
 - , theories, 554 ff
 - : vacancy aggregates, 538, 579
 - , vacancy concentration, 553
 - : vacancy jump frequencies, 589 ff
 - : vacancy wind term, 585, 589, 610 ff
- : Varotsos formula, 582
- : Zener formula, 582
- Diffusion coefficients**
 - : activation energy, 557
 - : anelasticity approach, 566 ff
- , anomalously high, 593 ff, 1187, 1746, 1807 ff
- at infinite dilution, 542
- : chemical (interdiffusion), 544, 608 ff
 - : experimental methods for measuring, 563 ff
- , classification, 543 ff
- : Darken's equations, 609
- : empirical prediction methods, 582
 - : Keyes relation, 582
 - : Nachtrieb relation, 582
 - : Van Liempt relation, 573
 - : Varotsos formula, 582
 - : Zener formula, 582
- : experimental methods, 562 ff
- : frequency factor, 557
- in dilute alloys, 542 ff, 582 ff
- , interdiffusion, *see* "chemical"
- , intrinsic, 540
- , phenomenological, 540
 - , Onsager reciprocity relation, 540
- : pressure variation, 558
- : relaxation methods, 565 ff
 - , Gorsky effect, 568
 - , magnetic relaxation, 569
 - , Snoek relaxation, 567
 - , Zener relaxation, 567 ff
- : self-, 544,
 - , in iron, changes due to phase transformation, 1560
 - , studied by inelastic neutron scattering, 1187 ff
 - , in pure metals, 572 ff
 - , tabulation, 575 ff
- , solute, 544
- : spectroscopic methods (NMR and Mössbauer), 570 ff
 - : quasielastic neutron scattering, 572
- , surface, 629
- : vacancy wind effect, 610 ff
- Diffusion creep (diffusional flow), *see* "Creep"**
- Diffusion-induced grain-boundary migration, 623 ff, 1461 ff, 2447**
 - , attributed to elastic coherency stress, 1463 ff
- Diffusion-induced recrystallization, 1467**
- Diffusional processes (in solid-state changes), 1371**
- Directional short-range ordering, 2535 ff, 2553 ff**
- Discommensurations, 1550**
- Dislocation(s), 1832 ff**
 - activation volume, 2180
 - : "atmosphere" drag, 1867 ff

- : attractive junctions, 1863
- (in) body-centred cubic metals, 1845
- : bowout, 1842, 1855 ff, 1860 ff, 2114 ff
- : Burgers vector, 1832
- : Burgers vector density, 2241
- cell formation, 1978 ff, 2134 ff
 - : flow stress in relation to cell size, 1839, 1922, 1930
- climb, 1863 ff, 1866, 1960, 2040 ff, 2186 ff
 - : climb resistance, 2186 ff
 - : general climb model, 2187
- core energy, 1845
- core structure, 1844 ff, 2084 ff
 - : planar and nonplanar in intermetallics, 2084 ff, 2089
- : Cottrell atmosphere, 1867
- created by moving grain boundaries, 897
- : critical velocity in a solid solution, 1971
- density
 - : changes during creep, 1985
 - (in) deformed iron, 1590 ff
 - (in) metal-matrix composites, 2584
 - : relation to yield stress, 1925
- diffusion,
- dipole, 1848, 2307
 - : loop patches, 2306
- edge, 1832 ff
- elastic field, 1834 ff
- etch pits, 1921, 1926,
 - , solid solutions, 2014
- : fatigue structures, *see* "Fatigue"
- : Fisher mechanism,
- : Fleischer-Friedel mechanism, 1903, 2018, 2187
- forest, 1862
 - : cutting, 1903 ff, 1926 ff
 - : flow stress in relation to forest dislocation density, 1838 ff
- , Frank partial, 1848
- : friction stress, *see* "Solute drag"
- (in) gallium arsenide, 1849 ff
- , geometrically necessary, 2124, 2358
- : Granato-Lücke internal friction theory, 1856
- , image strain (stress), 1840, 1881, 2120
- : initiation of precipitation, 889
- : interaction between dislocations, 1837
- : internal stresses (dynamic) 1984 ff
- , intrinsic (in interface), 1527
- : intrinsic resistance to motion, 1895 ff
 - : interplanar resistance, 1895, 1913, 1937
 - : intraplanar resistance, 1895, 1913, 1937
- jog, 1853 ff
 - , extended, 1854
 - : production, 1904
 - : superjog, 1854
- jog drag, 1865 ff
- : kinks, 1844
 - : motion, 1854 ff
 - types, 1844
- line tension, 1841 ff
 - (of) a bowed segment, 1842
- locking mechanisms, 2016 ff
 - : chemical locking, 2016 ff
 - : elastic locking, 2017
 - : electrostatic locking, 2017
 - : stress-induced order-locking, 2017 ff
 - : superimposition of different locking and drag mechanisms, 2020 ff
- : Lomer-Cottrell barrier, 1847, 2015
- loop analysis in the electron microscope, 1064 ff
- loop formation, 1063, 2121
- loop lattice, 893 ff
- mechanics in relation to continuum mechanics, 1947 ff
- mesh-length (link-length), 1839, 1923, 2417
 - : principle of similitude, 1923, 1928, 1981
 - : relation to yield stress, 1923
- , misfit, 2145
- : (dislocation) microstructure, 1920 ff, 1972, 1975 ff
 - , solid solutions, 2014 ff
- motion at high homologous temperatures, 1863 ff
- motion at low homologous temperatures, 1854 ff
- : Mott-Labusch mechanism, 2018
- node, 1834, 1839
 - , extended, 1848
- (in) ordered phases, 1850 ff
 - : core structure,
 - : slip systems, 1853
 - : superdislocation, 1850 ff
- : Orowan relation, 1869
- : osmotic climb forces, 1863 ff
- , partial, 1846, 2081
- : Peach-Koehler force, 1836 ff, 1864 ff, 1867
- : Peierls barrier (stress), 1843 ff
- pile-up, 1858 ff, 2195, 2198
- pinning, 1855 ff, 1897 ff, 2044 ff
 - : direct observation, 2047 ff, 2189
 - in alloys, 1860 ff

- : particle bypassing, 2046, 2119
 - : particle shear, 2044, 2048, 2116, 2194 ff, 2201
 - : (effect of) particle size, 1901 ff
 - : thermally activated penetration, 1893 ff
 - : plastic punching, 2594
 - : point forces acting on, 1855
 - : precipitate interaction, *see* "pinning"
 - : prismatic loop, 2121 ff
 - : Schwarz–Labusch mechanism, 2192
 - , screw, 1832 ff, 1845
 - , secondary,
 - (in) semiconductors, 1849 ff, 1855
 - , sessile, 1926
 - in Ni₃Al, 2089
 - , Shockley partials, 1847, 2181
 - : short-range order destruction by dislocation motion, 2021
 - : slip systems, 1852 ff (*see also* "Slip")
 - in body-centred cubic crystals, 1852
 - in face-centred cubic crystals, 1852
 - in hexagonal close-packed crystals, 1852
 - : small-angle scattering, 1178 ff
 - : solute drag and locking, 1866 ff, 2016 ff, 2018 ff
 - : microcreep, 2023
 - : superimposition of different mechanisms, 2020 ff
 - : thermal activation, 2021 ff
 - : sources, 1857 ff
 - : stacking-faults associated with, *see* "Stacking-faults"
 - : stair-rod partial, 1847
 - : stair-rod dipole, 1854
 - : storage, 1920 ff
 - : super-, 1850 ff, 2056 ff, 2081 ff
 - , motion at high temperature, 2061 ff
 - (and) planar faults, 2081 ff
 - : superpartials, 2081
 - : surface, elastic field near, 1839 ff
 - : threshold stress for detaching a dislocation from a dispersoid, 2188
 - : Thompson tetrahedron, 1846
 - : tilt boundary, 1078, 2413
 - : transmission electron microscopy, 1056 ff
 - : width of core, 1843
 - Dispersed-phase alloys**, 1897 ff, 2106 ff
 - : coherency loss, 2144
 - : creep, 2134 ff, 2154 ff, 2183
 - : high-temperature behavior, 2133 ff
 - : internal stress, 2128, 2136, 2138, 2155
 - (with) large particles, 2124 ff
 - : misorientation of matrix near particles, 2125 ff
 - , particle bypassing, 2119
 - : recovery, 2127, 2134
 - : recrystallization, 2158 ff (*see also* "Recrystallization")
 - : subgrain formation at high temperatures, 2134 ff
 - : tensile properties, 2111 ff
 - : threshold stress for detaching a dislocation from a dispersoid, 2188
 - Dispersion strengthening**, 1897 ff, 2106 ff
 - : distinguished from precipitation hardening, 1899
 - Displacements**, atomic, in crystals, 1102 ff, 1133
 - , thermal, 1102 ff, 1133
 - , static, 1105, 1133
 - Displacement cross-section**, 1649
 - Displacement spike**, 1684
 - Displacement threshold energy**, 1648 ff
 - Di–vacancy**, 1643
 - Dodecahedral symmetry**, 378, 391, 400
 - Doolittle equation**, 1732
 - Dorn equation**, 1964
 - Double diffraction**, 1038 ff, 1166
 - Droplet emulsion technique**, 693 ff, 698 ff
 - DSC lattice**, 847
 - Ductile–brittle fracture transition**, 1259 ff, 2280 ff
 - : grain-size effect, 2281
 - : strain-rate effect, 2281
 - : transition temperature, 2280
 - Dumbbell atoms**, 1659
 - Duplex structure**, microstructural change in, 878 ff
 - Duwez gun**, 1748
 - Dynamic recovery**, 1924, 1929, 2003
- E**asy glide, 2029
- Edge dislocations**, *see* "Dislocations"
- Effective interplanar spacing**, 1238
- Einstein relation** (random walk theory), 546
- Elasticity and anelasticity**, 1879 ff
 - : anelastic deformation, 1880 ff, 2132
 - : isomechanical scaling laws, 1999 ff
 - : elastic properties of metal–matrix composites, 2581 ff
 - : elastic strains developing during plastic deformation, 1923 ff
 - : rubberlike elasticity, 2735 ff
- Electrochemical effect**, 147
- Electrochemical measurement of activity**, 467 ff

Electrodeposition, study by scanning tunneling microscopy, 978
 Electromigration, 611 ff, 616 ff, 632, 886
 –, use for purification, 618
 Electron band formation, 63 ff
 Electron concentration, 107 ff, 147 ff, 325 ff
 Electron-beam microanalyser, 970 ff, 989
 Electron channelling patterns, 968 ff
 Electron energy bands, 50 ff
 Electronegativity difference, 108, 114 ff, 147, 161
 Electron energy loss spectroscopy, 1087, 1091 ff, 1217
 Electron irradiation, 1648 ff
 Electrons-per-atom ratio, *see* “Electron concentration”
 Electron phases, 108 ff, 111, 166 ff, 225
 –, hexagonal, 170
 Electron probe techniques, 992 ff
 Electron theory of metals and alloys, 48 ff
 Electronic specific heat, 173 ff
 Elements
 –, crystal structure, 2, 12 ff
 Elinvar alloys, 2541
 Ellingham diagrams, 429 ff, 1294 ff
 Ellingham line, 430 ff
 Ellipsometry, 960
 Embedded atom method (EAM), 2247, 2256
 Embrittlement
 –, hydrogen, 2217 ff, 2282 ff
 –, liquid-metal, 1386, 2286
 Energy band
 –: volume dependence, 72 ff, 84 ff
 Energy-dispersive X-ray analysis, 970 ff
 Energy gap, 70
 Energy levels of atoms, *see* “Atomic energy levels”
 Enthalpy of formation, *see* “Heat of formation”
 Enthalpy, 416, 499
 Entropy, 415
 – catastrophes, 1731
 –, configurational, 436
 –: measurement, 419 ff
 ESCA, 989
 Eshelby’s model of misfit strain, 2581 ff
 Etching, metallographic, *see* “Metallography”
 Eutectic, *see* “Phase diagrams” and “Solidification”
 Eutectoid coarsening, 1458 ff
 Eutectoids, lamellar spacings in, 1460 ff
 Eutectoidal decomposition, 1451 ff, 1468 ff
 Ewald sphere, 1101 ff
 Extended X-ray absorption fine structure (EXAFS), 1183

Fast diffusion, 593 ff, 1187, 1807 ff
Fatigue, 2294 ff
 – (in) age-hardened alloys, 2340, 2354 ff
 –: anisotropy factor, 2343 ff
 –: bicrystals, 2343 ff
 –: chemical environment, 2374 ff
 –: Coffin–Manson law, 2295, 2303
 –: copper–aluminum alloys, 2347 ff
 –: crack initiation
 -- (in) ductile metals, 2362 ff
 -- (at) grain boundaries, 2372 ff
 -- mechanisms, 2369 ff
 --: role of PSBs, 2363
 –: crack propagation, 2376 ff
 --: elasto-plastic fracture mechanics, 2378
 --: short crack growth, stage I, 2381 ff
 --, stage II, 2385 ff
 –: crack-tip blunting, 2389
 –: cyclic (plastic) deformation
 -- compared with monotonic deformation, 2336 ff
 -- (of) polycrystalline metals, 2338 ff
 –: cyclic hardening in fcc metals, 2295, 2297, 2300 ff
 -- in bcc metals, 2333 ff
 –: cyclic softening, 2295, 2300 ff
 –: cyclic stress-strain curves (CSSC), 2295,
 -- for single crystals (orientation dependence), 2309 ff
 –: defect structure studied by small-angle neutron scattering, 1181
 –: deformation mechanisms, 2312 ff (*see also* “rapid hardening, models”)
 –: dislocation cell structure, 2324 ff
 –: dislocation dipoles, 2307
 –: dislocation patterning (structures), 2308, 2361
 -- (in) copper–aluminum alloys, 2350 ff
 --: loop patches, 2306, 2311, 2317, 2321
 --: low-energy dislocations (LEDs), 2327, 2332
 --: maze structure, 2331 ff
 --: transition from loop patches to PSBs, 2315 ff
 --: walls (dipolar), 2320, 2333
 –: environmental effects, 2374 ff
 --, in vacuo, 2375
 –: extrusions and intrusions, 2363 ff
 --: formation mechanism, 2371 ff
 –: failure boundary maps, 2379
 –: grain-boundary migration during high-temperature fatigue, 2447 ff

- : grain-size effects, 2340 ff
- : hysteresis loops, 2314, 2348
- : history of phenomenon, 2294 ff
- life, 2303 ff
- limit, 2294
- (and) linear elastic fracture mechanics, 2296
- : metal-matrix composites, 2606 ff
- : non-linear (dislocation) dynamics, 2360
- (of) oxide-dispersion-strengthened alloys, 2189 ff
- : Paris curve, 2296
- : persistent Lüders bands, 2347
- : persistent slip bands (PSB), 2043, 2295, 2313, 2316 ff, 2321 ff
 - , models of dislocation behavior in, 2326 ff
 - , non-uniform strain in, 2322
 - , nucleated at (annealing) twins, 2317
 - : demonstration of strain concentration at, 2323 ff
- : plateau stress, normalized, 2305
 - , models, 2329
- : point-defect emission, 2331
- : protrusions (bulging), 2324, 2364
- : rapid hardening, 2304
 - : models, 2313 ff
- : recovery, 2408
- : saturation stress, 2305, 2321 ff
- : S-N curve, 2294, 2304
- : slip irreversibility, 2370, 2376
- : solid solutions, 2043
- , stainless steel, 2354 ff
- : steady-state (saturation) stress amplitude, 2303
- : strain bursts, 2312 ff
- : strain localisation, 2304, 2321 ff
- : striations (ductile), 2387 ff, 2390
- : Taylor lattice, 2314 ff, 2317
- : testing methods, 2297 ff
 - : constant amplitude stress tests, 2297 ff
 - : constant plastic strain amplitude tests, 2298 ff
 - : increasing stress amplitude tests, 2298
 - : results compared, 2339
 - : variable amplitude tests, 2299 ff
- (and) texture, 2342 ff
- : threshold for crack growth, 2381
 - , metal-matrix composites, 2606
- : (annealing) twins, stress-concentrating effects, 2342
- : Wöhler machine, 2294
- Fermi energy, 66
- Fermi sphere, 65, 108
 - , distorted, 109, 153, 171, 176
- Fermi surface, 71
 - and charge-density waves, 1549
- Ferrimagnetism, 2503
- Ferrite, 1568, 1570 ff
 - morphologies, 1571
 - solid-solution hardening (and softening), 1593
 - : strength, 1589 ff
- Ferromagnetism, 123 ff (*see also* "Magnetism")
- Fibers, polymer, 2700 ff
- Fibonacci sequence, 377 ff
- Fick's first law, 542
- Fick's second law, 545
- Fictive temperature, 2723
- Flory-Huggins equation, 2684
- Flow stress, *see* "Yield stress"
- Flux-line lattice
 - : neutron scattering, 1181
- Fractals, 866
- Fractography, 2213 ff
- Fracture, (*see also* Cracks")**
 - : amorphous alloys, 1798
 - , brittle, in practical situations, 2275 ff
 - : Charpy test, 2280
 - , chemically enhanced, 2271
 - : crack shielding, *see* "Cracks"
 - : critical Griffith stress, 2237
 - , ductile, 2220, 2277 ff
 - at interfaces, 2269 ff
 - : ductile-brittle transition, 1259 ff, 2280 ff
 - : grain-size effect, 2281
 - : strain-rate effect, 2281
 - : transition temperature, 2280
 - : (and) grain-boundary impurities, 1259 ff
 - : grain-size effects, 2277, 2281
 - : Griffith criterion, 2236 ff
 - : HRR crack-tip field, 2242 ff
 - : hole growth, 2278 ff
 - : hydrogen embrittlement, 2217 ff, 2282 ff
 - , ideally brittle, 2220
 - , intergranular, 2270 ff
 - : liquid-metal embrittlement, 2286
 - mechanics approach, 2276 ff
 - in fatigue, 2378
 - (of) metal-matrix composites, 2596 ff, 2604 ff
 - modes, 2212 ff, 2223 ff, 2380
 - , models, limitations, 2244 ff
 - : necking, 1949 ff
 - : R-curve, 2278 ff

- : stress intensity factor, 2222 ff
- : summary of concepts, 2272 ff
- : temper-brittleness, 1270 ff, 1281, 1612, 2285 ff
- : toughness concept, 2213, 2238
- : toughness parameters, 2236
 - of metal-matrix composites, 2604 ff
- : transformation-toughening, 2286 ff
- , work of, 1259 ff
- Frank partial dislocation**, 1848
- Frank-Kasper phases**, 225, 237, 306 ff, 392
- Frank-Read dislocation source**, 1857 ff
- Frank-Van der Merwe model**, 1222
- Free-electron approximation**, 64 ff
- Free energy**,
 - , Gibbs, 416
 - , Helmholtz, 416
 - of mixing (Gibbs), 436, 439, 475
 - , ideal, 445
 - , standard, 426
- Free volume**, 1731 ff, 2699
- Freezing**, *see “Solidification”*
- Frenkel defect (pair)** 1648 ff,
 - concentration, 1654
 - : effect on electrical resistivity, 1655
 - : formation enthalpy, 1666
 - production by irradiation, 1683 ff
- Friedel sampling length**, 1900
- Friedel-Fleischer theory**, 1903, 2018, 2187
- Fusion welding**, 803 ff

- Gadolinium**
 - : allotropy linked with magnetic changes, 33, 43
- Gallium**
 - crystal structure, 22 ff, 34
- Gibbs adsorption isotherm**, 453 ff, 458, 1205 ff, 1249, 1252
- Gibbs-Duhem equation**, 439
- Gibbs energy of fusion**, 492
- Gibbs free energy**, 416
- Gibbs phase rule**, 450
- Gibbs-Thomson effect**, 683, 733, 760
 - , for lamellae, 1453
- Gibbs-Thomson equation**, 1423
- Gibbs-Wulff theorem**, 1381
- Glass**
 - : Doolittle equation, 1732
 - : free volume, 1731
 - , polymer, 2720 ff
 - : thermodynamics, 1734
 - transition, 649, 1729 ff, 1733, 2720 ff
- Glassy reaction layers at interfaces**, 863 ff
- Gold-silver alloys**, 1152 ff
- Gorsky effect**, 568
- Grain aspect ratio**, 2170
- Grain-boundary**
 - allotriomorphs, 1571
 - : boundary periodicity, 849
 - : broken bond model, 850 ff
 - character distribution, 866
 - cohesion
 - : effect of solute segregation, 1258 ff, 1262, 1270 ff
 - : coincidence models, 847 ff
 - : coincidence site lattice, 844 ff
 - : computer simulations, 858
 - design, 866, 1282 ff
 - : diffusion, *see “Diffusion”*
 - : DSC lattice, 847, 1870 ff
 - : dislocation model, 853 ff, 1869 ff
 - , doped, in nanocomposites, 925 ff
 - embrittlement, 1259, 1270 ff, 2270 ff
 - energy,
 - , in terms of bond density, 852
 - , in terms of dislocation models, 853 ff, 1879
 - engineering, 2463
 - enrichment factor, *see “Segregation”*
 - fracture, 1259 ff
 - microchemistry, *see “Segregation”*
 - migration, 2440 ff
 - : acceleration by vacancies, 2450 ff
 - : ‘Beck approach’, 2442
 - , defects created by, 896 ff
 - , diffusion-induced, 623 ff
 - , impurity drag, 2440 ff, 2443 ff
 - : Kronberg-Wilson rotation, 2440
 - : low-angle boundaries, mobility, 2446
 - : misorientation effect, 2445 ff
 - : particle drag, 889
 - : (in) primary recrystallization, 2440 ff
 - : (effect of) recovery, 1588
 - : segregation effects, 1248
 - : special orientations, 2448 ff
 - : strain-induced migration, 2435 ff
 - models, limitations of, 856 ff
 - (in) nanocrystalline materials, 911 ff
 - , atomic structure, 916 ff
 - : O-lattice theory, 846
 - pinning, 1009, 2159, 2467 ff
 - : planar structure factor, 851
 - : polyhedral unit models, 855
 - : quasiperiodicity in boundaries, 850

- : secondary dislocations, 1076
- segregation, *see* "Segregation"
- sliding, 1960, 1992 (*see also* "Creep")
 - : during creep, 1993 ff
 - (of) individual grain boundaries, 1995
 - : Lifshitz-type, 1992
 - : Rachinger-type, 1992
- : Sigma (Σ) value, 845 ff, 2462
- , small-angle, 2446
- , special, 848
- : structural unit models, 848 ff, 1077
- : symmetry model (Pond), 1871
- : tilt boundary, 1078, 2413
- : transmission electron microscopy of, 1075 ff
- , vacancies in, 2450 ff
- (as) vacancy sinks, 2632
- Grain growth**, *see* "Recrystallization"
- Grain (orientation) clusters**, 865
- Grain refinement**, 810 ff, 1811
 - : critical supercooling, 811
 - , energy-induced, 814 ff
 - : inoculation methods, 812 ff
- Grain size**
 - aspect ratio, 2170
 - (prior) austenite, 1604 ff
 - : creep rate, effect on, 1991 ff
 - , determination, 1006 ff
 - distribution, 1008
 - effects in fatigue, 2339 ff
 - effects in nanocrystalline materials, 918 ff
 - in solidification, 700, 810 ff
 - : yield stress, effect on, *see* "Hall-Petch relationship"
- Granato-Lücke internal friction theory**, 1856 ff
- Graphite structure**, 288
- Grassfire transformation**, 1015
- Grazing-incidence X-ray scattering**, 858 ff
- Greninger-Troiano orientation relationship**, 1514
- Griffith crack and criterion**, 2236 ff
- Growth of precipitates**, 1393 ff
 - , diffusion-controlled, 1402 ff, 1404 ff
 - , dual martensitic and diffusive, in aluminum-silver alloys, 1407
 - : growth instabilities, 1421 ff
 - : absolute instability, 1424
 - : relative instability, 1424
 - , interface-controlled, 1402 ff
 - : interface velocity, 1399
 - : involving long-range diffusion, 1400 ff
 - : kinetics, 1415 ff
 - , (with) ledges, 1396, 1405 ff, 1409 ff
 - : computer simulation, 1410, 1412 ff
 - : ledge formation, 1415
 - : linear growth models, 1427 ff
 - : needle-like crystals, 1427 ff
 - : massive phases, *see* "Massive transformation"
 - : metastable phases, 1398
 - : mixed control, 1402
 - : rates, 1415 ff
 - : solute drag, 1396 ff
- Growth of solid from liquid**, *see* "Solidification"
- Growth steps**, *see* "Growth of precipitates, (with ledges)"
- Guinier approximation**, 1163 ff
- Guinier-Preston zones**, *see* "Pre-precipitation"

Hafnium

- : polymorphism, 20, 24
- Hägg phases**, 225
- Hall-Petch relationship**, 1008 ff, 1589 ff, 1605, 1811, 1815 ff, 1859, 2168 ff
 - and fracture, 2277
- Hamiltonian**, 59
- Hardening** (*see also* "Yield stress")
 - : diamond structure, 2038 ff
 - , fcc solid solutions, 2011 ff
 - , forest, 2133
 - , latent, 2133
 - , magnetic,
 - : NaCl structure, 2038 ff
 - , order-, 2055 ff, 2192
 - : maximum at intermediate order, 2060
 - : quench effects, 2062
 - : temperature effects, 2063 ff
 - : theory, 2059 ff, 2195 ff
 - , precipitation-, 2043 ff, 2106 ff, 2141 ff
 - : Al alloys, 642, 1805 ff, 2049 ff
 - , classification, 2141, 2192
 - : deformation modes, 2147
 - : dislocation pinning, 1861, 1897 ff
 - : hardening mechanisms, 2147 ff
 - (under) high stress, 2144 ff
 - , iron-carbon alloys, 2052 ff
 - , kinetics, 634
 - : reversion, 1807
 - (*see also* "Pre-precipitation" and "Superalloys")
 - , quench-, 2062 ff
 - (due to) rapid solidification, iron, 1594
 - : short-range order, 2017, 2021, 2061 ff
 - , solid-solution, 1593 ff, 2011 ff
 - , bcc solid solutions, 2034 ff
 - , fcc solid solutions, 2023 ff, 2143
 - , hcp solid solutions, 2032 ff

- : plateau hardening, 2024 ff
- : stress equivalence, 2022
- , theory, 2016 ff (*see also* "Dislocations, locking mechanisms")
- Heat capacity, 417 ff
- Heat of formation, simple metal phases, 141
- Heat transfer in solidification, 670 ff
- Helmholtz free energy, 416
- Henry's law, 442
- Herring–Nabarro–Coble creep, 1988 ff
- Heterogeneous nucleation, *see* "Nucleation"
- Heusler alloys, 194, 272
- High-resolution electron microscopy**, 1035, 1079 ff, 1110, 1112
 - applied to amorphous alloys, 1777
 - applied to grain interfaces, 858 ff
 - : image reconstruction, 1084
 - : optical transfer function, 1081 ff
 - : (of) quasicrystals, 372, 389, 399
 - : Scherzer focus, 1083
 - : weak-phase object approximation, 1083 ff
- High-strength low-alloy steels, *see* "Steels"
- Holes, octahedral and tetrahedral, 277 ff
- Hönl correction, 1121
- Homeotect structures, *see* "Polytypism"
- Homogeneous equivalent medium, 2182
- Homogeneous nucleation, *see* "Nucleation"
- Hot isostatic pressing, 2579, 2644
 - maps, 2647 ff
 - : sensors for measuring compact dimensions *in situ*, 2649
 - : technological considerations, 2648 ff
- Hot pressing, 2644 ff
 - : densification models, 2645 ff
 - : densification stages, 2645
- Hot-salt corrosion, 1317 ff
- Huang scattering, *see* "X-ray scattering"
- Hume–Rothery phases, *see* "Electron phases"
- Hume–Rothery rules, 142 ff
 - and strain in solid solutions, 162
- Hydrogen**
 - , atomic energy levels, 53
 - diffusion, 593, 1187
 - embrittlement, 2217
 - , migration in stress gradients, 895
 - : heats of solution in metals, calculation, 118
 - in iron, 1253, 1279, 1615
 - in niobium, 1384
 - solubility in Laves phases, 177
- Hydrogen embrittlement, 2217 ff, 2282 ff
- Hypercooling, 1756
- I**mage analysis, *see* "Quantitative metallography"
- Incommensurate phases, 1549
- Incommensurate-to-commensurate transformations, 1550 ff
- Inelastic scattering, 1126 ff
- Icosahedral symmetry, 378, 384, 391 ff, 396 ff
 - : hypercubic phases, 395 ff
- Ingot structure**, 781 ff
 - : chill zone, 781 ff
 - : columnar zone, 782 ff
 - : columnar to equiaxed transition, 786 ff
 - : computer modelling, 783 ff
 - : equiaxed zone, 785 ff
 - : inclusions, 794 ff
- Inoculants, 812 ff
- Interatomic pair potential, 95 ff, 98, 121
- Interface**
 - , adsorption at, 1203, (*see also* "Segregation")
 - , thermodynamics, 1205 ff
 - , coherent, 1396, 2107 ff
 - cohesion, 1258 ff, 1262, 1270 ff
 - : coincidence model, 844, 847
 - controlled growth of precipitates, 1402
 - , curved, 458 ff
 - , diffuse, 707
 - energy, 850 ff, 1210 ff, 1395
 - as affected by segregation, 1249 ff
 - enrichment factor (ratio), 1209,
 - (and) fracture, 2269 ff
 - : Frank–Van der Merwe model, 1222
 - , glissile, 1524
 - : conservative motion, 1526
 - , heterophase, *see* "interphase"
 - , incoherent, 2108
 - instability in solid–solid transformations, 1421 ff
 - , interphase, 859 ff, 1078 ff
 - kinetics, 700 ff
 - , ledged, 1405 ff, 1409 ff
 - , martensite–parent, 1524 ff
 - microchemistry, 1202 ff (*see also* "Segregation")
 - and materials design, 1280 ff
 - : methods of measurement, 1209 ff
 - moving, causing transformation, 1451 ff
 - : segregation, *see* "Segregation"
 - , semi-coherent, 864, 1379, 1524 ff, 2108
 - , solid–liquid, *see* "Solidification, liquid–solid interface"
 - : thermodynamics, 1205 ff, 1228
 - transmission electron microscopy, 1075 ff

- Interfacial process (in solid-state changes), 1371
- Interference-layer contrast, 957 ff
- Interferometry in optical microscopy, 960
- Intermediate phases, 166
 - , homogeneity range, 490
 - , solid solubility in, 137 ff, 151, 166, 178 , 490
- Intermetallic compounds**
 - : binary, electron per atom ratio, 107
 - : binary, relative size factor, 107
 - : binary, stability of structure, 102 ff
 - : commonest structure types, 323
 - , congruently (or incongruently) melting, 491
 - : coordination number, 231
 - , ratios, 228
 - : coordination polyhedra, 229
 - , as building blocks, 238 ff
 - : crystal-chemical relationships, 263
 - , crystal structures, 206 ff, 2141 ff
 - , data bases and books, 264 ff
 - , representation, 214 ff
 - : statistical distribution of types, 315 ff
 - : cubic structure types, 343
 - : definition, 206
 - : derivative and degenerate structures, 247
 - : "gazetteer" of structures, 355 ff
 - : Gibbs energy of formation, 492
 - , ideal and approximate formulae, 211
 - , identifying symbols, 209 ff
 - in phase diagrams, 489 ff
 - : interstitial structures, 249 ff
 - : isotropic and isopointal, 221
 - : lattice complexes, 217 ff
 - : Laves's stability principles, 326 ff
 - : layer stacking sequence, 231 ff, 246
 - : mechanical properties, 2076 ff
 - , non-stoichiometric, 501
 - , order in, 193 ff, 248
 - : oxidation, 1309
 - : recombination structures, 260 ff
 - : reduced strain parameter, 334 ff
 - : site occupation formulae, 213
 - , solid solubility in, *see "Intermediate phases"*
 - , space-filling principle, 326 ff, 331 ff
 - , stability, 317 ff
 - , stacking symbols, 233 ff
 - , stoichiometric ratios, 317
 - , strength as function of homologous temperature, 2077
 - , structural notations, alternative, 241 ff
 - : structure families, 247 ff, 265 ff
 - : structure prediction, 345 ff
 - , structure types, 220 ff
 - : atomic-environment classification, 342 ff
 - , systematic description, 264, 267 ff
 - : superstructures (superlattices), 248 ff
 - , ternary, 507
 - : structure distribution, 321
 - , type names, 224 ff
 - : vacant sites, ordered, 248
- Internal friction,
 - : Bordoni peak, 1857
 - : Granato-Lücke theory, 1856
 - : Niblett-Wilks peak, 1857
- Internal oxidation, 2108 ff
- Internal stresses
 - : dispersed-phase alloys, 2128 ff
 - during creep, 1984 ff
- Interphase boundaries, 859 ff
 - : chemistry, 862 ff
 - : crystallographic structure, 864
 - with reaction (intermediate) layers, 862 ff
- Interstitial (self-)**
 - agglomeration, 1673 ff
 - : cluster size, 1674 ff
 - configuration, 1663 ff
 - created by dislocation intersection, 1904
 - diffusion, one-dimensional, 1706
 - dumbbell configuration, 1140, 1659 ff, 1673 ff
 - dynamic properties, 1658 ff, 1672 ff
 - enthalpy of formation, 1656 ff, 1665 ff
 - enthalpy of migration, 1666 ff
 - experimental approach, 1663 ff
 - free steels, 1594 ff
 - ion-channeling method, 1680
 - lattice, 894
 - mechanical relaxation method, 1681
 - mechanism of diffusion, 594 ff
 - Mössbauer effect, 1681
 - multiple, 1662 ff
 - phonon coupling, 1184
 - position, *see "Interstitial position"*
 - production, 1647 ff
 - properties
 - , calculation, 1654 ff, 1657
 - relaxation volume, 1663
 - saddle-point configurations, 1656 ff
 - solid solutions, 139
 - , thermodynamic analysis, 501
 - solute interaction, 1676 ff
 - split, 1659 ff
 - trapping by solutes, 1678 ff

- -vacancy interaction, 1651 ff
 - : close pairs, 1653
 - : spontaneous recombination, 1651 ff
- X-ray scattering from, 1136
- Interstitial positions
 - : body-centred cubic structure, 1562
- Invar alloys, 2540 ff
- Inverse melting, 1734 ff
- Ion-beam mixing, 637
- Ionic bond, 61
- Ionicity, degree of, 61, 137
- Ion microprobe analysis, *see* "Secondary-ion microscopy"
- Ion-probe techniques, 989 ff
- Ion-scattering spectroscopy, 1214 ff
- Iron**, 1556 ff
 - allotropy, 20 ff, 30 ff, 1416
 - : effect of substitutional solutes, 1566 ff
 - : property changes at phase change, 1560
 - : thermodynamics, 1558
 - : role of entropy of demagnetization, 1558 ff
 - carbides, 1563 ff
 - precipitate microstructure, 2053
 - carbon phase diagram, 771, 1565
 - carbon solid solution, 1561 ff, 2035
 - : precipitation hardening, 2052 ff
 - : discontinuous yield, 2052 ff
 - chromium-cobalt permanent magnet alloys, 2517 ff
 - , cleavability, 2217
 - diffusion rates of interstitial and substitutional solutes compared, 1563
 - dislocation density in deformed iron, in relation to flow stress, 1590 ff
 - fatigue behavior, 2334 ff, 2382
 - : interstitial alloys, 1561 ff,
 - : fatigue, 2334 ff
 - : flow stress, 2035, 2037
 - : interstitial plus substitutional alloys, 1568 ff
 - nitrides, 1563 ff, 1571
 - nitrogen solid solution, 1561 ff, 2037
 - octahedral and tetrahedral voids, 1562
 - , phase transition, 1416 (*see also* "allotropy")
 - , phosphorus in, 1208, 1214, 1215, 1237, 1272, 1582, 2271
 - : properties of pure element, 1557 ff
 - : solubility of elements in, 1556, 1563
 - : strength of ferrite, 1589 ff
 - : substitutional alloys, 1566 ff
 - : effect on form of gamma-field, 1566 ff
 - , sulphur in, 1224, 1582
 - : vacancies in α -iron, 1558
 - : yield stress, in dependence on temperature and grain size, 1583 ff
- Iron aluminides, 2078
 - as soft magnetic materials, 2533 ff
- Iron-chromium alloys, 2035
- Iron-oxygen-sulphur system, 1312 ff, 1316
- Iron-silicon steels, *see* "Silicon steels"
- Irradiation (effects)**
 - : amorphization, 1758 ff
 - (in) amorphous alloys, 1804
 - : atom redistribution, 640 ff, 1708
 - : biased point-defect annihilation, 1697
 - : cavities, electron microscopy of, 1066
 - : defect clusters, 1689 ff
 - : dislocation wall lattice, 1703
 - : effects, miscellaneous, 1682 ff
 - : collision (displacement) cascade, 1684 ff
 - : displacement spike, 1684
 - : intracascade defect reactions, 1688 ff
 - : electron, *see* "Electron irradiation"
 - , fast heavy-ion, 1690 ff
 - : enhanced diffusion, 635 ff
 - : induced creep, 1700 ff
 - : induced Guinier-Preston zones, 1709
 - : induced phase transformation, 643, 1709
 - : induced precipitation, 640 ff
 - : induced segregation, 640 ff, 1708
 - : loss of order, 1687
 - : swelling, 1695 ff
 - , reduction, 1698 ff
 - : void formation, 1695 ff (*see also* "cavities")
 - : void rearrangement, 1706 ff
 - : void lattice, 1701 ff
- J**anecke coordinates, 518
- Jellium, 861
- Jogs, 1853 ff, 1904
- Johnson-Mehl-Avrami-[Kolmogorov] (JMA[K])
 - kinetic equation, 1435 ff, 1788, 2421, 2674
 - : relation to soft impingement, 1435 ff
 - : necessity for a spatially uniform driving force, 1436
- Jominy test, 1579
- Jones theory of solid solubility, 151 ff
- K**agomé net, 234, 246
- Kauzmann paradox, 1731
- Kerr effect, 957

Kikuchi lines, 969, 1040
 Kinematical diffraction theory, 1094 ff, 1117 ff,
 Kinking, 1912 ff
 Kirkendall effect, 608 ff, 1625
 -, inverse, 1709
 Kossel patterns, 969
 Kronberg–Wilson rotation, 2440
 Kurdjumov–Sachs orientation relationship, 1571

Labusch's theory of hardening in solid solutions, 2019 ff
 Langevin law, 2502
 Langmuir adsorption isotherm, 456 ff, 1252
 Langmuir–McLean theory, 1219 ff
 Lanthanides
 – crystal structures, 28 ff, 39 ff, 100
 –, dependence of properties on atomic number, 351 ff
 Laplace equation, 2631
 Laser surface treatment, 1760 ff
 Lattice complex concept, 217 ff
 Lattice strain in solid solutions, 161 ff
 Lattice spacing,
 – in primary solid solutions, 180 ff
 – in ternary alloys, 181 ff
 Lattice stability, *see* "Structure stability"
 Laves phases, 176 ff, 310 ff
 –: heats of formation, 117
 Lead
 –: unusually large atomic radius, 25
 Ledges, *see* "Growth of precipitates"
 Lever rule, 473, 506, 715
 Liquid–solid interface, *see* "Solidification"
 Line compounds, 206
 Lifshitz–Slyozov–Wagner theory, 873
 Liquid crystals, 2680
 Liquids
 –, fragile and strong, 1733
 –: specific heats, 1733
 Liquid simple-metal alloys
 –: heats of formation, 116
 Liquid–metal embrittlement, 1386, 2286
 Liquid–solution calorimetry, 2402
 Liquidus, 472
 Local density functional, 50, 90, 101
 Long-period superlattices, 195 ff, 894, 1544 ff
 Lomer–Cottrell barrier, 847, 2015
 Lüders bands, 1586, 2023
 –, persistent, 2347
 – (in) polymers, 2695 ff

Mackay icosahedron (cluster), 395, 406
 Macrosegregation, 789 ff
 Magnesium
 – aluminum alloys, 1457
 – cadmium alloys, 2032 ff
 – crystal structure, 16
 –, solid solutions based on, 183
 – zinc alloys, 2033
Magnetic
 – aftereffect, 2507
 – anisotropy, 2505, 2509, 2512
 –, amorphous alloys, 2551 ff
 –, directional-ordering, 2535 ff, 2553 ff
 –: shape anisotropy, 2512
 –, slip-induced, 2535
 –, thermomagnetic, 2535
 – annealing, 2535
 – coercivity, 2507
 – in relation to microstructure, 2513 ff, 2521
 –: curling, 2513
 –: defects and domain-wall pinning, 2514
 – domain wall(s)
 – pinning, 2514
 – thickness, 2512
 – domain(s), 2505 ff
 –, nucleation and growth, 2512, 2514
 – reversal, 2510 ff, 2520
 – reversal in relation to microstructure, 2513 ff
 – rotation, 2510 ff
 – force microscopy, 976
 – 'hardening' in relation to mechanical hardening, 2514
 – materials, *see* "Magnetic materials"
 –: maximum energy product, 2507
 – measurements, 2507 ff
 –: Hall-effect probe, 2508
 – permeability, 2506, 2527
 – properties of materials, 2501 ff
 –, fundamental, 2502 ff
 – relaxation, 2556
 – scattering of neutrons, 1123 ff
 – structure factor, 1124
 – susceptibility, 2502, 2506
Magnetic materials, 2501 ff
 –, amorphous, 2543 ff
 –: anisotropy, 2551 ff
 –, anisotropy, induced, 2535 ff, 2553 ff
 (*see also* "Directional short-range ordering")

- : core loss, 2557
- : Curie temperature, 2546 ff
- : low-field properties, 2555 ff
- : magnetostriction, 2553 , 2555
- : preparation, 1748 ff, 2544 ff
- : saturation magnetization, 2546 ff
- : temperature dependence of magnetization, 2549 ff
- permanent, 2510 ff
 - , cobalt–platinum, 2523 ff
 - , cobalt–rare earth, 2519 ff
 - : crystal-anisotropy materials, 2519 ff
 - : effect of plastic deformation, 2518
 - : electrodeposited rod-shaped materials, 2516
 - : hard ferrites, 2522 ff
 - , iron–rare earth, 2521 ff
 - : list of properties, 2511
 - : manganese–aluminum–carbon (non-magnetic constituents), 2523
 - : shape-anisotropy materials, 2525 ff
 - : spinodal alloys, 2516 ff
 - : two-phase (ferromagnetic plus paramagnetic), 2517
- (for) recording heads, 2543
- soft, 2524 ff
 - : high-permeability alloys (permalloy, supermalloy), 2536
 - : invar alloys, 2540 ff
 - : iron–aluminum–(silicon) alloys, 2533 ff
 - : iron and low-carbon steels, 2525 ff
 - : iron–cobalt alloys, 2541 ff
 - : iron–silicon alloys, *see* “Silicon steels”
 - : nanocrystalline alloys, 2542 ff
 - : nickel–iron alloys, 2534 ff
 - : square-loop alloys, 2539
- Magnetic measurements in metallurgy, 2558 ff
 - : hysteresis loop, applications, 2559
 - : thermomagnetic analysis, 2558
 - : magnetic anisotropy, 2559
- Magnetically modulated structures, 260
- Magnetism**
 - and lattice parameters, 184 ff
 - : core loss, 2510, 2528, 2557
 - : demagnetizing field, 2509
 - : diamagnetism, 2502
 - : directional short-range ordering, 2535 ff, 2553 ff
 - : eddy-current loss, 2507
 - : exchange for ces , 2503
 - : hysteresis curve, 2507
 - : residual magnetization, 2507
 - : saturation magnetization, 2507, 2546 ff
 - : skewed-loop alloys, 2540
 - : square-loop alloys, 2539
 - : superparamagnetism, 2513
- Magnetocrystalline anisotropy energy, 2505
 - : anisotropy constants, 2509
- Magnetometer, vibrating–sample, 2508
- Magnetostriction, 2505, 2510, 2553, 2555
- Manganese
 - aluminum–carbon magnetic alloys, 2523
 - : crystal structures, 20, 27 ff
- Maraging steels, 1607 ff
- Martensite**
 - aging, 1580 ff
 - , crystal structure, 274
 - growth, 1524 ff
 - like structures in rapidly solidified pure iron, 1594
 - , low-carbon, 1603
 - (to) martensite transformation, 1543 ff
 - morphology, 1510 ff, 1522 ff, 1576
 - , banded, 1522
 - , butterfly, 1525
 - : laths, 1522 ff, 1526, 1576
 - : midrib, 1524
 - : needle shape, 1522
 - , thin-plate, 1525, 1576
 - nucleation, 1530 ff
 - parent interface, 1524 ff
 - , dislocations in, 1522 ff
 - plates, 1510 ff
 - : premartensitic state, 1550
 - : semicoherent interfaces, 1524
 - (in) steels, 1572 ff
 - strength, 1602 ff
 - as function of carbon content, 1603
 - as function of tempering, 1606
 - stress-induced, 1540, 1912
 - substructure, 1517 ff, 1522
 - : surface martensite, 1522
 - : surface relief, 1510 ff
 - temperature, 1509
 - tempered,
 - strength and ductility, 1604 ff
 - tempering, 1579 ff
 - variants, 1538 ff
- Martensitic transformation**, 1508 ff, 1572 ff
 - , athermal and isothermal, 1531
 - : Bain distortion and correspondence, 1512, 1515, 1520
 - : butterfly morphology, 1525

- : critical stress, 1535 ff
- : crystallographic theory (phenomenological, 1514 ff
 - : complementary shear, 1514
 - : dilatation parameter, 1521
 - : lattice-invariant deformation, 1514, 1526, 1531
 - , mathematical description, 1518 ff
- (as) displacive transformation, 1532 ff
- : driving force
 - , chemical, 1532 ff
 - , mechanical, 1533 ff
- : Greninger–Troiano orientation relationship, 1514
- : habit plane, 1511 ff, 1515, 1517, 1521
- : hysteresis, 1527
- : inhomogeneous shear, 1517 ff
- : invariant-line strain, 1514, 1520
- : invariant-plane strain, 1511, 1520
- : mechanical effects, 1531 ff
 - , M_d temperature, 1536
 - , M_s temperature, 1509, 1535, 1572, 1574 ff
 - : effect of precipitation on, in steels, 1574
- : orientation relationships, 1512 ff, 1516, 1571
- : oxides, 1544
- : pseudoelasticity, 1541 ff
- (in) rapidly solidified steels, 1815 ff
- , reverse, 1527
- : rigid-body rotation, 1513
- : shape–memory effect, 1538 ff (*see also* “Shape–memory effect”)
- : shape strain, 1510
- : stabilization of austenite, 1575
- : thermoelastic, 1527 ff (*see also* “transformation-induced plasticity”)
- : thermodynamics, 1529 ff, 1533
- : transformation–(induced) plasticity, 1532, 1536 ff
- : twinning, 1517 ff
- Massive transformation, 1393, 1398, 1417, 1577
- Mataño method, 546
- Maximum resolved shear stress law, *see* “Schmid law”
- Maxwell element, 2726 ff
- Mechanical alloying, 2109, 2167
- Mechanical milling, 1766 ff
- Mechanical threshold, 1886
- Mechanical properties of single-phase crystalline materials, 1878 ff, 1957 ff (*see also* “Elasticity”, “Plastic deformation” and “Creep”)
- Mechanochemical reactions, 923
- Melt, transient conductance measurement, 1761
- Melt-extraction, 1749
- Melt-spinning, 1749
- Melt subdivision method of studying nucleation, 693 ff
- Melting
 - , inverse, 1734 ff
 - , surface, 978
- Mendeleev number, 102, 211
- Mercury
 - crystal structures, 22, 32
- Mesotextures, 2460 ff
 - : grain-boundary character distribution, 2462
 - : grain-boundary misorientation distribution, 2460 ff
 - : Rodrigues method, 2460
- Metal–ceramic interfaces, 859 ff
- Metallic character, criteria, 149
- Metallic glasses, *see* “Amorphous alloys”
- Metallography,**
 - , definition, 944
 - : etching, 950 ff
 - : anodic oxidation, 952
 - : interference-layer contrast, 952 ff
 - : ion-etching, 951
 - : grinding, 947
 - : image analysis, *see* “Quantitative metallography”
 - : polishing, 948 ff
 - , chemical, 948 ff
 - , electrolytic, (electrochemical) 948 ff
 - , thermal, 948
 - : ultramicrotoming, 949
 - , quantitative, *see* “Quantitative metallography”
 - : replica techniques for TEM, 950
 - : specimen preparation, 945 ff
 - : specimen sampling, 945 ff
 - : stereology, *see* “Quantitative metallography”
- Metal-matrix composites (*see also* “Composites”)
 - by solidification, 824 ff
- Metal recycling, 1283 ff
- Metastability (in alloys)**
 - : categories
 - , compositional, 1727 ff
 - : configurational freezing, 1728
 - , kinetic, 1727
 - , morphological, 1727 ff
 - , structural, 1727 ff
 - , methods for achieving, 1725 ff
 - : microstructural manifestations, 1724
 - , nature of, 1726 ff

- Metastable phases by undercooling, 699 ff,
 - Metastable structures, 192 ff, 771, 1562, 1569, 1724 ff
 - Metastable equilibrium at melt–solid interface, 684
 - Metastable phase diagrams, 684 ff, 701, 772, 1735
 - Microchemistry of grain boundaries and surfaces, 1202 ff
 - Microhardness, 961
 - Microscopy**
 - , acoustic, 980
 - , analytical electron, 1086 ff
 - , atomic-force, 974 ff
 - , applications, 977 ff
 - , atom-probe field-ion, 982 ff
 - , applications, 983 ff
 - , Auger-electron (scanning), 986 ff
 - , electron-channeling, 968 ff
 - , field-electron, 983
 - , field-ion, 981 ff, 1626
 - , applications, 983 ff
 - , fluorescence, 988
 - , high-resolution electron, *see* “High-resolution electron microscopy”
 - , optical, 945 ff
 - , confocal, 958 ff
 - , high-temperature, 959
 - , illumination, 955 ff
 - , interference contrast, 958
 - , interferometry, 960, 1211
 - , near-field (scanning), 959,
 - , phase contrast, 957
 - (with) polarized light, 956 ff
 - , resolution and depth of focus, 955
 - , scanning, 958 ff
 - , orientation imaging microscopy, 865, 969 ff, 2462
 - , photo-electron emission, 985 ff
 - , quantitative television,
 - , scanning Auger electron, 986 ff
 - , scanning electron, 961 ff
 - , scanning transmission electron,
 - , contrast modes and detectors, 964
 - , contrast, atomic-number, 967 ff
 - , contrast, backscattered electron mode, 962
 - , contrast, cathodoluminescent, 971
 - , contrast, electron-channeling, 968 ff
 - , contrast, magnetic, 970
 - , contrast, secondary-electron mode, 962
 - , contrast, topographic, 967
 - : depth range, 963
 - : images, 965
 - : signal processing, 963
 - : specimen preparation, 966
 - : stereomicroscopy, 971 ff
 - : X-ray mapping, 970 ff, 1217
 - , scanning acoustic, 979 ff
 - , applications, 980
 - : scanning techniques, various, 976 ff
 - , scanning thermal wave, 979 ff
 - : scanning tunneling, 973 ff
 - , applications, 977 ff
 - , surface, 943 ff
 - , thermal wave, *see* “scanning thermal wave microscopy”
 - , transmission electron, *see* “Transmission electron microscopy”
 - : tunneling spectroscopy, 976
 - , applications, 979
 - , X-ray, 987 ff
- Microsegregation**, 726, 749, 1204 (*see also* “Segregation”)
- Microstructural transformations**, 866 ff
 - : coarsening by Brownian motion, 882
 - , driven by interfacial energy reduction, 870 ff
 - due to electric fields, 886
 - due to magnetic fields, 885
 - due to stress fields, 885 ff
 - due to thermal cycling, 884
 - in presence of temperature gradients, 883 ff
 - , experimental techniques for studying, 1372 ff
 - initiated by moving dislocations, 889
- Microstructure**, 844 ff, 944 ff
 - : characterization, 865 ff
 - : definition (constituent elements), 844, 944
 - : development, 870 ff
 - , self-organized (periodic), 890 ff
 - : superalloys, 2076
- Miedema’s model for heats of formation, 111 ff, 141, 349 ff
- Miscibility gap**, 478
 - , liquid–liquid, 483
 - , solid–solid, 478
- Misfit strain**
 - from differential thermal contraction, 2584
 - : Eshelby’s model, 2581 ff
- Mixing energy (Gibbs)**, 475
- Mohr diagram**, 2129 ff
- Mössbauer effect**
 - : interstitial atoms, 1681

- Molecular dynamics simulations
 - (of) crack structure, 2246 ff
 - (of) irradiation effects, 1685 ff, 1691
- Molybdenum–rhenium alloys, 2038
- Monotectic, 483, 771 ff
- Monotonic Laue scattering, 1145
- Morse potential, 1624
- Mosaic structure of crystals, 1132
- Motional narrowing (in NMR), 570
- Mott (metal–insulator) transition, 81
- Mott–Labusch mechanism, 2018
- Mould–metal system
 - : air gap, 673
 - : computer-modelling, 680 ff
 - : freezing at mould wall, 676 ff
 - : heat transfer, 673 ff
- Multiphase alloys, mechanical properties, 2106 ff
- Mushy zone, 672, 792
-
- N**abarro–Herring–Coble creep, 1988 ff
- Nanocomposites, 923
- Nanocrystalline materials**, 908 ff
 - : catalytic properties, 935
 - : consolidation, 916 ff
 - (with) doped grain boundaries, 925 ff
 - : generation methods, 914 ff
 - : giant magnetoresistance, 932 ff
 - : grain growth in, 2479 ff
 - : luminescence from nanocrystalline porous silicon, 933 ff
 - (for) magnetic recording, 932
 - : soft magnetic, 930, 2542 ff
 - : technological applications, 928 ff
- Nanoglasses, 921 ff
- Nanostructured materials, 900 ff, 1800 ff
 - : magneto-caloric cooling, 931 ff
- Nearly-free electron approximation, 64, 151
- Néel point, 2504
- Neodymium
 - crystal structure, 39
- Nernst–Einstein relation, 550
- Neutron
 - : absorption coefficient, 1120 ff
 - : radiation, 1119 ff
 - : sources, 1128 ff
- Neutron scattering**, 1116 ff
 - : aluminum-r alloys, 1140
 - : Bragg peaks, *see “X-ray”*
 - : diffuse near Bragg peaks, 1134 ff
 - : diffuse between Bragg peaks, 1139 ff
 - : diffusive motion, 1187 ff
- : inelastic, 1126 ff
- : isotope replacement, 1145, 1155
- : magnetic, 1123 ff, 1179
- : order (short-range), 1144 ff
- : small-angle, 1161 ff (*see also “Small-angle Scattering”*)
- Niblett–Wilks peak, 1857
- Nickel, recovery from deformation, 2403
- Nickel–aluminum alloys (mainly Ni₃Al)**, 1173, 1178, 1180, 1186, 1218, 1241, 1260, 1261, 1308, 1391 ff, 1426, 1441, 1447, 1488, 1853, 2046, 2076 ff, 2084, 2146, 2452, 2473
 - : plastic deformation and the flow stress anomaly, 2085 ff, 2195 ff
 - : catalogue of features, 2086
 - : creep, 2196
 - : models, 2086 ff
 - : particle shear, 2201
- NiAl, mechanical properties, 2091 ff
- Nickel-base high-temperature alloys, 2171 (*see also “Superalloys”*)
 - : micromechanisms of plasticity, 2190 ff
- Nickel–chromium alloys, 1157 ff
- Nickel–cobalt alloys, 2015
- Nickel–manganese alloys, 2059
- Nickel–oxygen–sulphur system, 1316
- NiO band structure, 80 ff
- Niobium alloys
 - , hydrogen in, 1384
 - : oxidation, 1309
 - : phase distortions due to solutes, 1141 ff
 - superconducting Nb–Ti, examined by small-angle neutron scattering, 1174 ff
- Nitrogen in iron, 1561 ff
- Noble metals
 - : crystal structures, 21
 - , lattice spacings in solid solutions of, 180 ff
- Nondestructive testing, 2276
- Nowotny phases, 258 ff
- Nuclear magnetic resonance, 570 ff
- Nucleation**
 - : alloys, solidification, 695 ff
 - (in) amorphous alloys, 1784 ff
 - and growth transformations, 1369 ff, 1374 ff
 - , cavity, 1265
 - : critical radius, 688 ff
 - (of) disorder, 1766
 - , experimental methods, 693 ff
 - : experimental findings, 1389 ff
 - : orientation relationships, 1389
 - from the melt, 687 ff
 - (at) grain boundaries, 1807

- heterogeneous, 689, 697 ff, 1378, 1385 ff, 1389
 - (at) dislocations, 1387
 - (at) GP zones, 1387
 - (at) grain boundaries and edges, 1386 ff
 - (at) grain boundaries, with lattice matching, 1388 ff
 - : test of theory, 1393 ff
- homogeneous, 689, 1374 ff, 1389 ff, 1756 f
- metastable, 1389 (*see also* "Precipitation")
 - (in) primary recrystallization, 2425 ff
- pure metals, solidification, 693 ff
- rate, 691 ff
 - : strain effects, 1384 ff
- theory, 1374 ff
 - : critical radius, 1375
 - : experimental tests, 1390 ff
 - : nucleation rate, 1376
- Nusselt number, 1756

- O**ctagonal symmetry, 378, 381 ff
- O-lattice theory, 845 ff
- Omega phase formation, 1546 ff
- Optical microscopy, *see* "Microscopy"
- Orbitals, 4 ff, 51 ff, 59
- Order in solid solutions**, 121, 193 ff, 198 ff, 252 ff
 - : antiphase domains, *see* "Antiphase domains"
 - : creep, 2064 ff, 2078, 2080
 - : destruction by irradiation, 1687
 - : diffraction pattern, 1039 ff
 - : diffusion in ordered phases, 599 ff
 - : dislocations in ordered phases, *see* "Dislocations"
 - : flow stress, 2059 ff
 - : hardening, *see* "Hardening"
 - : lattice parameter change, 2060 ff
 - : long-range, 198 ff
 - : magnetic field effects,
 - : magnetic, in relation to chemical SRO, 1158 ff
 - : mechanical properties, 2059 ff
 - : neutron scattering, 1144 ff
 - : parameter, 198
 - : recrystallization, 2471 ff
 - : short-range, 198 ff,
 - : computer simulation, 1149 ff
 - : directional, 2535 ff, 2553 ff
 - : in liquids, 501
- : kinetics, 570
- : parameters, 1145 ff
- : quasichemical theory of, 450
- : studied by diffuse scattering of X-rays and neutrons, 1144 ff
- : superdislocations, 1850 ff, 2056 ff, 2081 ff
- : vacancies in, 1646 ff
- : X-ray scattering
 - , short-range order, 1142 ff
- Order-disorder transformations**, 251 ff, 494, 1544 ff
- Ordered crystal structures**, 252 ff
 - : electron microscopy of, 1039 ff
 - : stability, 121
- Ordering**
 - and clustering, thermodynamics of, 437
 - , continuous, 1370, 1490 ff
 - energy, calculation, 119 ff
- Orientation function (parameter)**, 2680 ff
- Orientation distribution function**, 2456
- Orientation imaging microscopy**, 865, 969 ff, 2462
- Orowan loops, 1893, 1900, 1948, 2115 ff
- Orowan mechanism, 2114 ff, 2148
- Orowan stress, 2046, 2185
- Orthogonal plane-wave method**, 73
 - : repulsive contribution from, 73
- Ostwald ripening**, 460, 873 ff, 1437 ff, 2144
 - (at) early stage of precipitation, 1444 ff
 - : inhibition by solute segregation to particle interfaces, 1274 ff
 - : late-stage coarsening, 1442 ff
 - : radius distribution, 1438, 1441
 - , effect of this on kinetics, 1439
 - : scaling laws, 876
 - : stability against coarsening, 877
 - : technological applications, 878
- Overshoot in slip**, 2029, 2056
- Oxidation**
 - (of) alloys, 1306 ff
 - , cyclic, 1328
 - : dissociative mechanism, 1301
 - (of) intermetallics, 1309
 - , internal, 1309
 - : internal stress, measurement, 1330 ff
 - : kinetics, 1297 ff
 - , measurement, 1325 ff
 - , parabolic, 1299
 - : Wagner's theory, 1299 ff
 - : life prediction modelling, 1338 ff
 - , mechanism, 1298 ff, 1328 ff
 - (of) metallic materials, 1292 ff
 - (in) multicomponent atmospheres, 1311 ff, 1335 ff

- , preferential, 1294 ff
- (in a) solution, thermodynamics, 449 ff
- , selective, as a function of alloy composition, 1306 ff
- , surface, inhibition by segregants, 1279 ff
- : thermodynamics, 1293 ff
- , transient, 1308
- Oxide layers**
 - , diffusion in, 1303 ff
 - : electrical properties, 1303
 - : macrodefects, measurement, 1334 ff
 - : mechanical properties, 1304 ff
 - : scale adhesion, 1309 ff
 - : scale failure, detection, 1333 ff
 - : spallation, 1305 ff
 - , stress generation and relief in, 1305 ff
- Oxide-dispersion-strengthened alloys, 1310, 2107, 2184 ff, 2187
 - : high-temperature fatigue properties, 2189 ff
 - , recrystallization, 2203 ff
- Oxides
 - , amorphous, 1296
 - , crystalline, non-stoichiometry, 1296 ff
- Oxide stability, 1293 ff
 - (of) mixed oxides, 1314 ff

- P**acking densities (atomic) in elements, 12
- Pair distribution function, 1769 ff
- Particle drag on grain boundaries, 889, 1443
- Particle hardening, *see also* "Dispersion-strengthening" and "Hardening, precipitation-"
 - : macroscopic behavior, theory, 2182 ff
 - : particle shearing, 2044, 2048, 116, 2194 ff, 2201
 - : threshold stress, 2185 ff
- Pauli exclusion principle, 48
- Peach-Koehler force, 1836 ff
- Pearlite, 1564, 1570 ff, 1600
- Pearson (structure type) symbol, 223
- Peclet number, 714 ff, 733
- Peierls barrier (stress), 1843 ff, 1894 ff
- Pencil glide, 1585
- Penrose tiling, *see* "Quasiperiodic tilings"
- Peritectic, *see* "Phase diagrams"
- Peritectoid, *see* "Phase diagrams"
- Permalloy, 2536
- Periodic table of the elements, 14, 54 ff
- Persistent slip bands, *see* "Fatigue"
- Perturbed γ - γ angular correlation, 1636, 1638
- Phase (interphase) boundary, 453 ff
 - , limiting slope, 488
 - , metastable, 699 ff
- Phase diagrams**, 472 ff
 - , binary, 472 ff
 - : calculation from thermodynamic input, 495 ff
 - , optimization of phase boundaries, 496 ff
 - , ternary and multicomponent systems, 516 ff
 - : classification, 482 ff, 524 ff
 - : compilations, 530
 - : computer-coupled analysis, 495
 - , constant-composition section, *see* "ternary-isopleth (section)"
 - : eutectic systems, 480 ff
 - , ternary, 507
 - : extension rule, 493
 - : gaseous phase in, 503, 519 ff
 - : interdiffusion, use of for measuring, 529
 - : invariant reactions, nomenclature, 515
 - , iron-carbon, 1565
 - : law of adjoining phase regions, 513
 - : measurement techniques, 525 ff
 - : metastable, *see* "Metastable phase diagrams"
 - : miscibility gaps, 478 ff
 - , monotectic, 483
 - , multicomponent, 514 ff
 - : peritectic, 483 ff
 - , ternary, 508
 - : peritectoid, 493
 - , with potentials as axes, 518 ff
 - : quenching techniques, 528
 - : syntetic, 485
 - , ternary, 503 ff
 - : isopleth (section), 512
 - : isothermal sections, 509 ff
 - : polythermal projection, 506
 - : thermal analysis, 526 ff
 - : thermodynamic interpretation, 443 ff, 474 ff
 - : tie-lines, 473
 - , topology of binary, 492 ff
 - , topology of ternary, 511 ff
 - : two-phase fields, extrema in, 477
 - : zero phase-fraction lines, 515
- Phase equilibria**, 472 ff
 - : equilibrium constant, 426
 - , heterogeneous and activity measurement, 464
 - in a one-component system, 422 ff
 - : stability diagrams, 434
 - : triple point, 424
- Phase morphology, 866
- Phase rule, 450
 - : components, 451
 - : degrees of freedom, 450
 - : species, 451

- Phase stability, 140 ff, 434
 - : calculation, 142 ff
- Phase transformations, *see* "Transformations" and "Solidification"
- Phonon modes, 1141
- Phonon spectra
 - : by inelastic neutron scattering, 1183 ff
 - : Kohn anomalies, 1185
- Phonon wind, 883
- Phonons, role in diffusion theory, 555 ff
- Photon probe techniques, 994 ff
- Pilling–Bedworth ratio, 1305
- Piobert–Lüders band, *see* "Lüders band"
- Piston-and-anvil quenching, 1749
- Pitsch orientation relationship, 1572
- Planar flow-casting, 1749 ff
- Plastic deformation** (*see also* "Deformation", "Dislocations" and "Slip")
 - : activable cluster, 1887 ff
 - : activation area for dislocations, 2180
 - : activation parameters for plasticity, 1891 ff, 2180
 - : activation time, 1884
 - : activation volumes, apparent and true, 2180
 - : amorphous alloys, 1796 ff
 - : asymmetric, bcc metals,
 - : athermal stage, 2180
 - : cyclic and monotonic deformation compared, 2336 ff
 - : critical resolved shear stress for glide, 1885 ff
 - in presence of diffusion, 1957 ff
 - : instability in tensile deformation, 1949 ff
 - : jump experiments, 1892
 - : kinking, 1912 ff
 - resulting from dislocation glide, generalities, 1881 ff
 - : stress-strain curves, *see* "Stress-strain curves"
 - : thermally activated, 1887 ff
- Plasticity
 - , continuum (phenomenological), 1946 ff, 2698 ff
 - : Mohr diagram, 2129 ff
 - : von Mises condition, 1946, 2590, 2698
- Plutonium
 - : allotropy, 34, 44
- Pnictides, 36
- Point defects**, 1622 ff
 - clusters, 1180 ff
 - condensation, 896
- created by intersecting dislocations, 1904
- created by moving grain boundaries, 896 ff
- : effect on precipitation, 894 ff
- : emission during fatigue, 2331
- : lattice, 894
- , small-angle scattering from clusters, 1180 ff
- , X-ray scattering by, 1136 ff, Point compounds, 206
- Poisson's ratio, 1880
- Polarized-light microscopy, 956 ff
- Polysynthetic twinning, 2096 ff
- Pole figures, 2456 ff
- Polishing, metallographic, *see* "Metallography"
- Polycrystals, plastic deformation of, 1940 ff
- Polygonization, 2410 ff
- Polymer science**, 2663 ff
 - : alloys (blends), 2682 ff
 - : critical solution temperatures, 2685
 - : entropy and enthalpy of mixing, 2683 ff
 - : polymer-polymer miscibility, 2684 ff
 - : amorphous polymers, 2665 ff
 - , chain conformations (structures), 2730 ff
 - : chain conformations and solvent effects, 2733 ff
 - : chain statistics, 2732 ff
 - , textures in, 2677 ff
 - : viscoelasticity model, 2729 ff
 - : annealing of polymers, 2671
 - : chain folding, 2670 ff
 - : concept of crystallinity with respect to polymers, 2668 ff
 - : conjugated polymers, 2713 ff
 - : copolymers, 2689 ff
 - , block, , 907 ff, 2689 ff
 - , random, 2691 ff
 - : crazing, 2707 ff
 - : anisotropy of craze initiation, 2710
 - : craze criteria, 2707
 - : environmental effects, 2710
 - , microstructure and mechanisms, 2710 ff
 - , propagation, 2709 ff
 - : crystal thickening, 2671
 - : crystals, single, of (poly)diacetylene, 2672
 - : crystallinity, percentage, 2670
 - : crystallization, sluggishness of, 2668
 - : deformation (plastic) of polymers and metals compared, 2692 ff
 - : director, 2679
 - : drawing of polymers, 2697 ff
 - : natural draw ratio, 2697

- : equilibrium diagrams, *see* "phase diagrams of polymeric systems"
- : electrical conduction, 2712 ff
 - , conjugated polymers, 2713 ff
 - , applications, 2718 ff
- : fibers, 908, 2700 ff
 - , conventionally drawn, 2703 ff
 - , high-performance, 2705
 - , Kevlar, 2672
 - , microstructure, 2704
 - , theoretical axial modulus, 2700 ff
- : fibrils, 2673
- : glass transition, 2720 ff
 - , control, 2724 ff
 - , interpretation, 2725
 - , melt or rubber?, 2725 ff
- : liquid-crystalline polymers, 2705
- : lyotropic phases (systems), 2667, 2687
- : naming of polymers, 2668, 2669
- : non-periodic layer crystals, 2692
- : phase diagrams of polymeric systems, 2684 ff
- : (poly)acetylene, 2713 ff
 - , band structure, 2714
 - , polarons, 2717
 - , solitons, 2715 ff
- : (poly)ethylene
 - : modification of crystal morphology, 2672 ff
 - : relationship to diamond structure, 2702
- : polymer-solvent systems, 2686 ff
- : relationship to physical metallurgy, 2664 ff
- : rubberlike elasticity, 2735 ff
 - : affine deformation of a network, 2735
 - : bond rotation in real chains, 2731 ff
 - : dependence of entropy on strain, 2737 ff
 - : entropy spring concept, 2736
 - : high-strain anomaly, 2739 ff
 - : stress-strain curve, 2738 ff
- : rubbers, 2725 ff
 - , structure, 2734 ff
 - , vulcanization, 2726
- : semicrystalline, 903 ff
 - : spherulitic crystallization, 905, 2673
- : textures of polymers, 2676
 - : orientation functions (parameters), 2680
 - : rolling textures, 2680 ff
 - : texture (strength) parameter, 2679 ff
- : thermoplastics, 2655 ff
 - , amorphous (non-crystalline), 2665 ff
 - , drawing, 2696
 - , liquid-crystalline, 2667
 - , semicrystalline, 2666 ff
- : thermosets, 2665
- : thermotropic polymers, 2667
- : viscoelasticity, 2726 ff
- Polymorphism**, 10 ff
- Polytypism**, 7 ff, 257, 286 ff, 310 ff, 384
- Porod approximation**, 1165
- Porosity**, 793 ff
 - and gas in melt, 793 ff
 - and sintering, *see* "Sintering"
- Porous silicon**, 933 ff
- Portevin–Le Chatelier effect**, 2042
- Positron-annihilation spectrometry**
 - and the Fermi surface, 175
 - and interstitials, 1681
 - and vacancy concentrations, 1633, 1636 ff
- Powder metallurgy**, *see* "Hot Pressing", "Hot isostatic pressing" and "Sintering"
- Powder solidification**, 679 ff
- Praesodymium**, crystal structure, 42
- Precipitate(s)**
 - , coherency, 2107, 2109
 - : -dislocation interaction, *see* Hardening, precipitation-
 - dissolution, 1431 ff
 - : equilibrium shape, 1380 ff, 1405 ff, 1426
 - free zones, 895
 - : grain-boundary migration,
 - growth, 1393 ff (*see also* "Growth")
 - growth instability,
 - growth under stress, 1465 ff
 - : imaging in the electron microscope, 1067 ff
 - , incoherent, *see* "Interface"
 - lattice, 892
 - : needle morphology, 1396
 - , plate-like, *see* "Widmanstätten precipitates"
 - reversion, 1433 ff
 - : segregation to interfaces, 1274 ff
 - , semicoherent, *see* "interface"
 - , shearable, 1898
 - : solute pileup at growing precipitates, 1244 ff
 - stress (in and around),
 - , Widmanstätten, *see* Widmanstätten precipitates"
- Pre-precipitation**, 1140, 1143, 1155 ff, 1166 ff, 1369, 1385, 1485, 1709, 1806 ff, 1861, 2360

Precipitation

- aided by moving dislocations, 889
- combined with coarsening, 1444 ff
- : competitive growth
 - : early stages, 1435 ff
- : competitive dissolution of small precipitates, before precipitation is complete, 1443 ff
- , discontinuous, 1456 ff
- , driving forces for, 1365 ff
- , enhanced by point defects, 894 ff
- : growth, *see* "Growth"
- hardening, *see* "Hardening"
- in nanoporous materials, 915
- (of an) intermetallic phase, thermodynamics, 1367
- , irradiation-induced, 896
- : Johnson–(Avrami)–Mehl kinetics, 1435 ff, 1788, 2421
- : nucleation, *see* "Nucleation"
- : soft impingement effect, 1426, 1435 ff
- : strain energy effects, 1383 ff
- thermodynamics, 1366 ff

Preferred orientations, *see* "Textures"

Premartensitic effect, 1550

Primary solid solutions, solubility in, 150 ff

Principle of similitude, 1923, 1928, 1981

Protection of metallic materials, 1343 ff

Protective coating technology, 1343 ff

- : diffusion coatings, 1345 ff
- : future trends, 1354 ff
- : laser processes, 1351
- : overlay coatings, 1348 ff
- : physical vapor deposition, 1349 ff
- : spraying processes, 1350 ff

Protective coatings

- , mechanical properties, 1353 ff
- , oxidation and hot-salt resistance, 1351 ff
- , thermal stability, 1352 ff

Pseudoelasticity, *see* "Shape–memory effect"

Pseudopotential (empty-core), 73 ff, 95, 150

Quantitative metallography (quantitative microstructural analysis), 989 ff

- : image analysis, 997 ff
 - , automation, 999
 - , instrumentation, 1001
- : mathematical morphology, 1014 ff
- : stereology, 1001 ff
 - : applications, *passim*, 1001 ff
 - : arrangement parameters, 1013 ff

- : contiguity, 1010 ff
- : curvature, 1012 ff
- : grain size, 1006
- : interface density, 1004 ff
- : mean intersect area, 1006
- : orientation of interfaces, 1010 ff
- : particle size distributions, 1007 ff
- : planar features in relation to three-dimensional variables, 1002
- : shape distributions, 1008 , 1011 ff
- : topological parameters, 1012
- : volume fraction analysis, 1003

Quantum numbers, 51

Quasicrystals (quasiperiodically ordered structures), 372 ff

- : approximants, 373, 379 ff, 385
- : external; facets, 400, 405
- : higher-dimensional approach, 376 ff
- : hyperatoms, 385, 392, 403, 407 ff
- , one-dimensional, 380
- , orientational order in, 375
- , structure, 379 ff, 395 ff, 404
- : superspace groups, 385, 398
- , symmetry, 378
- : tiling, 375, 390
- , two-dimensional, 380
- : X-ray structure analysis of an alloy of decagonal symmetry, 388

Quasi-elastic neutron scattering, 572

Quasiperiodic tilings, 374 ff

Quasiperitectic equilibria, 508

R

Radial (electron) probability density, 56 ff

Radiation effects, *see* "Irradiation effects"

Radius of gyration, 1164

Rafting, *see* "Superalloys"

Random walk motion

- in a crystal, 546 ff
- in a glass, 649 ff

Raoult's law, 436

Rapid quenching from the melt, *see* "Solidification, rapid"

Rapid solidification processing (RSP), *see* "Solidification, rapid" and "RSP crystalline alloys"

- : pseudo-RSP, 1758

Rare earth metals, *see* "Lanthanides"

Rayleigh instability, 880

Reaction equilibrium in solutions, 447 ff

Read–Shockley equation, 1870, 2412

Reciprocal lattice, 68, 1043, 1097 ff

- Recovery from deformation**, 2401 ff
- : aluminum, 2403 ff
 - : annealing textures, effect of prior recovery on, 2418
 - : cell formation, 1978, 2412 ff
 - : cell evolution, 1980, 2418
 - : cell size in relation to flow stress, 1981
 - (in) copper...does it exist?, 2402 ff, 2407
 - : (role in) creep, 1973 ff
 - : dislocation density reduction, 1978
 - , dynamic, 1924, 1929, 2003, 2030 ff, 2127, 2408
 - : dynamic secondary recrystallization, 2486
 - : fatigue-strain enhanced, 2408
 - : impurity influence, 2403
 - : iron alloys, complete recovery, 2405 ff
 - : kinetics, 2405 ff
 - , theories of kinetics, 2417 ff
 - , (of) mechanical properties, 2405 ff
 - , meta-, 2408 ff
 - , ortho-, 2410
 - : polygonization, 2410 ff
 - (in) steels, 1587
 - : stored internal energy and its recovery, 2401 ff
 - , stress-enhanced, 2406 ff
- Recovery of electrical resistivity after irradiation, 1692 ff
- Recovery of electrical resistivity after quenching**, 1634 ff
- : resistivity per interstitial, 1654 ff
 - : resistivity per vacancy, 1629 ff
 - : stage I, 1667 ff
 - : stage II, 1674 ff
 - : stage III controversy, 1622 ff, 1636 ff, 1640, 1670 ff
 - , use to determine volume of vacancy formation, 1628
 - (and) vacancy concentrations, 1634
- Recrystallization**, 2419f
- : annealing textures, *see "Annealing textures"*
 - : classification of phenomena, 2400
 - diagram, 2421 ff
 - , directional, 1818, 2205
 - , dynamic, 1999 ff, 2453 ff
 - : grain-boundary migration, *see "Grain boundary"*
 - : **grain growth**, 870 ff, 2474 ff
 - , epitaxial, 2491 ff
 - : grain-size distribution, 2476
 - : impurity influence, 2475
 - : kinetics, 2476 ff
 - : mechanism, 2474 ff
 - (in) nanocrystalline materials, 2479 ff
 - (and) pores, 2642 ff
 - : second phase influence, 887 ff, 2476
 - (and) sintering, 2492 ff, 2642 ff
 - : stagnation in thin films, 2490 ff
 - : texture inhibition, 2477
 - : thickness inhibition, 2476 ff
 - (in) thin films, 2489 ff
 - kinetics, 1588, 2421 ff
 - : effect of minor solutes on precipitates in steels, 1588 ff
 - : laws of recrystallization, 2419
 - , metadynamic, 2164, 2454
 - : neutron radiation influence, 2451
 - : **nucleation**, 2425 ff
 - : models, 2427
 - , oriented, 2427 ff
 - : role of inhomogeneity of orientation after deformation, 2428 ff
 - : strain-induced grain-boundary migration, 2435 ff
 - : nucleation, stimulated, 216,
 - : subgrain coalescence, 2435 ff
 - : techniques of investigation, 2425
 - , twin-based, 2438 ff
 - (of) ordered alloys, 2471 ff
 - : antiphase domain creation during, 2471 ff
 - : retardation of grain-boundary migration, 2471 ff
 - , primary,
 - : annealing textures, 2205
 - : critical strain, 2420
 - : growth of grains, *see "Grain-boundary, migration"*
 - : hot working, *see "dynamic"*
 - : impurity influence, 2423 ff
 - : kinetics, 1588, 2421 ff
 - : Kronberg-Wilson rotation, 2440
 - : microgrowth selection, 2435
 - : nucleation of grains, *see "nucleation"*
 - : recrystallization-controlled rolling, 2455
 - : retardation due to recovery, 2424
 - , secondary, 2482 ff
 - : driving force, 2483
 - , dynamic, 2486
 - : role of disperse phase, 2485, 2487
 - (and) sintering, 2492
 - , surface-controlled, 2487 ff
 - texture, 2486 ff, 2488

– (and) sintering, 2492 ff
 – (in) steels, 1587 ff
 –, tertiary, 2487 ff
 -: threshold strain for recrystallization, 2420
 – (of) two-phase alloys, 2158 ff, 2203 ff,
 2463 ff
 --: grain-boundary pinning, 2467 ff
 --: micromechanisms, 2163 ff
 --: misorientation near large particles,
 2125 ff, 2466
 --: nucleation at particles, 2463 ff
 --: effect of particle spacing, 2161 ff,
 2464 ff
 -: vacancies in grain boundaries, 2450 ff
 –: Zener force, 1009, 2159
Recycling of metals, 1283 ff
Reduced dimensionality, 900 ff
Relative valency effect, 147
Relaxation methods in diffusion measurements,
 565 ff
Renormalization, 91
Replacement collision sequence, 1651
Reversion, 1807
Rheocasting, 826 ff, 829
Richard's rule, 419, 476
Rigid band approximation, 109, 151
Rodrigues method, 2460
Rough liquid–solid interface, 702 ff
Roughness transition at surfaces, 626
RSP (rapid-solidification-processed) crystalline
 alloys, 1809 ff
 –: aluminum alloys, 1795 ff, 1810, 1812 ff
 –: steels, 1594, 1809 ff, 1814 ff
 –: superalloys, 1817 ff
Rubberlike behavior
 – in alloys, 1542 ff
 – in polymers, 2735 ff

Samson phases, 314 ff
Scanning electron microscopy, *see* “Microscopy”
Scanning transmission electron microscopy,
 1217 ff
Scanning tunneling microscopy, *see* “Microscopy”
Scheil equation, 715, 749, 751 ff
Schmid's law, 1852, 2086
Schmid strain resolution tensor, 1882, 1885
Schreinemakers's rule, 511, 513
Schrödinger equation, 48
Screw dislocation, *see* “Dislocations”
Secondary-ion mass spectrometry, 1215 ff
Secondary-ion microscopy, 1217

Segregation

–: adsorbate–adsorbate interactions, 1229 ff,
 1232 ff, 1272 ff
 – and materials design, 1280
 – (during) austenizing, 1582
 –, competitive, 1272 ff, 1281 ff
 –: complex effect of chromium on, 1272
 – (in) complex metallurgical systems, 1233 ff
 –: effect on mechanical properties, 1263 ff
 –: enrichment factor (ratio), 1209, 1222
 --: correlation with solubility, 1222 ff
 –, equilibrium, 1202, 1203, 1218 ff, 1239
 –: Fowler theory, 1229, 1231, 1233
 –, free energy of segregation
 --: to grain boundaries, 1221 ff
 --: to surfaces, 1225 ff
 --: temperature dependence of, 1230 ff
 –: grain-boundary segregation, 1202 ff, 2271,
 2285
 -- (at) asymmetrical grain boundaries,
 1237 ff
 --: composition-depth profiles, 1213,
 1216
 --: computer simulation of, 1238 ff
 --: correlation with segregation at
 surfaces, 1240 ff
 -- (and) grain-boundary diffusion, 1254 ff
 --: micrographic techniques, 1216 ff
 --: grain-boundary segregation diagram,
 1224, 1226
 -- at moving grain boundaries, 1248
 -- (in) steels, 1214 ff, 1263 ff, 1595,
 1612 ff
 --: orientation effects, 1225
 – (at) symmetrical grain boundaries,
 1235 ff
 – in multicomponent systems, 1234
 –: interaction of distinct segregants, 1272
 –, interfacial, methods of measurement,
 1209 ff
 –, interfacial, thermodynamics, 1205 ff
 –: irradiation-induced, 640 ff, 1708
 – kinetics, 1242 ff
 –: Langmuir–McLean theory, 1219 ff
 –: Maxwell–Boltzmann relation, 1219
 –, non-equilibrium, 640, 1204, 1218 ff,
 1244 ff, 1708
 –, quench-induced, 1245 ff
 –: site competition, 1232 ff, 1243
 –, stress-induced, 1248
 –: substitutional segregation model, 1229
 –, surface, 1225 ff, 1240 ff

- (and) surface diffusion, 1254 ff
 - : ternary systems, 1272
 - theory, 1218 ff
 - , quasichemical, 1225 ff
 - Selenium**
 - crystal structures, 26 ff, 38
 - Self-diffusion**, 572 ff
 - Semicrystalline polymers**, 903 ff
 - Sendust alloy**, 2533 ff
 - Serrated flow**, 1869
 - Shape analysis**, 1010 ff
 - Shape-memory effect**, 1538 ff
 - : pseudoelasticity, 1541
 - : rubber-like behavior, 1542 ff
 - : thermomechanical recovery stress, 1541
 - : superelasticity, 1541 ff
 - : martensite-to-martensite transformations, 1543 ff
 - : training, 1540
 - , two-way, 1540
 - Shear planes, crystallographic**, 260
 - Shockley partial dislocation, Short-range order**,
see "Order in solid solutions"
 - Sigma phase**, 178
 - Silicon**
 - , amorphous, 1729, 1761
 - , liquid, 1729, 1761
 - : phase change under pressure, 1768 ff
 - , porous, 933 ff
 - Silicon steels (ferromagnetic)**, 1252, 1614 ff, 2526 ff
 - : domain configuration, 2528 ff
 - : gamma loop, 2526
 - : grain size, 2530 ff
 - , high-silicon, 2533
 - : magnetic properties, 2526 ff
 - : effect of stress, 2528 ff
 - in relation to deviations from ideal grain orientation, 2528 ff
 - in relation to magnetic properties, 2532
 - : production methods, 2531 ff
 - : recrystallization, 2484
 - : grain-oriented, 1614 ff, 2528 ff
 - : (effect of) surface smoothness, 2531
 - Silver-aluminum alloys**, 2025, 2029
 - Silver-gold alloys**, 2024
 - SIMS**, *see "Secondary ion mass spectrometry"*
 - Single-crystal growth**, 809 ff
 - Sintered aluminum powder**, 2107
 - Sintering**, 2627 ff
 - (of) amorphous powders, 2638 ff
 - : densification, 2638
 - : dislocations, role of, 2632 ff
 - : driving energy, 2630 ff
 - : effect of chemical reactions, 2631 ff
 - : grain-boundary role, 2632 ff
 - (and) grain growth, 2492 ff, 2642 ff
 - , liquid-phase, 2650 ff
 - maps, 2636
 - : microstructure development, 2642 ff
 - : monosized particles, 2641
 - neck growth equation, 2633
 - : pore drag and coalescence, 2643
 - : pore geometry, 2630, 2643
 - porosity, time dependence, 2638
 - : pressure-sintering, *see "Hot pressing"*
 - : (and) secondary recrystallization, 2492 ff
 - : shrinkage, accelerating and retarding influences, 2639 ff
 - : shrinkage kinetics (equation), 2636, 2640
 - : numerical approaches, 2640
 - : shrinkage, local, 2637
 - : particle center approach, 2635, 2637
 - : particle size distribution and pore size distribution, 2641
 - , pressureless, 2628
 - , solid-state, 2628 ff
 - : technological outlook, 2653 ff
 - (and) surface energy, 2630
 - : undercutting, 2635
 - : zero-creep technique, 2630
- Size factor**, 144, 154 ff, 157 ff, 330, 348
- Slip**
 - and glide distinguished, 1883
 - band,
 - , persistent, *see "Fatigue"*
 - : bcc crystal, 1852, 1907
 - : coarse slip (in) fatigued alloys, 2043
 - , cross-, 2090, 2123, 2200
 - : easy glide in fcc alloys, 2029
 - : fcc crystal, 1852, 1907
 - : hcp crystal, 1852, 1907
 - irreversibility in fatigue, 2370
 - : lattice rotation, 1884 ff
 - lines (bands)
 - , pure metals, 1918 ff, 1933
 - , solid solutions, 2013 ff
 - : overshoot in fcc alloys, 2029, 2056
 - planes, 1852
 - systems, 1852 ff, 1906 ff
 - : tabulation, 1908
- Small-angle scattering of X-rays and neutrons**, 1161 ff
 - : alloys, 1166 ff

- from dislocations, 1179 ff
- from point-defect clusters, 1180 ff
- : multiple scattering, 1182
- : precipitation in aluminum-zinc alloys, 1166 ff, 1486 ff
- Snoek effect, 567
- Sodium,
 - : Wigner-Seitz theory of bonding, 51
- Sodium chloride structure, hardening, 2038 ff
- Solidification**, 670 ff
 - : amorphous alloy formation, 1728 ff
 - , binary alloy, 709 ff
 - : cell formation, 725 ff, 731 ff, 754, 765
 - : cell spacing, 741 ff
 - : collision-limited growth model, 706
 - , computer modelling, 680 ff, 704, 706
 - : constitutional supercooling, 721
 - , criterion, 724
 - : constrained growth, 732 ff
 - : continuous growth of solid, 704 ff, 710
 - , controlled, 679, 681 ff
 - : convection, 780
 - cooling rates during rapid quenching, 1752 ff
 - : dendrite formation, 731 ff (*see also* "dendrite" and "dendritic growth")
 - , diffusion-controlled, 714, 717
 - , directional, 679, 681 ff
 - : disorder trapping, 712 ff
 - (in) drop tubes, 1757
 - : electron-beam surface treatment,
 - : equilibrium freezing, 714 ff
 - , **eutectic**, 756 ff
 - : branching-limited growth, 765
 - : classification, 757
 - : coarsening after solidification, 878 ff
 - colonies, 765
 - : competitive growth, 765 ff
 - : coupled growth, 758
 - : coupled zone, 765 ff
 - , divorced, 767
 - : growth rates, 758 ff, 765 ff
 - : liquid/solid interface, 758 ff
 - : lamellar instability, 762
 - : lamellar vs rod growth, 758
 - : modification, 815 ff
 - : non-facetted-facetted, 763 ff
 - , rapid solidification, 768 ff
 - : supercooling, 761
 - : faceted growth, 708
 - : fluid flow, 780 ff
 - : grain size, 700
 - : heat transfer, 670 ff
 - (at) high undercoolings, 1756 ff
 - : hypercooling, 1756
 - : inclusions, 794 ff
 - : ingot structure, 781 ff
 - : interface kinetics, 700 ff
 - : interface temperature, 710 ff
 - : laser surface treatment,
 - : **liquid-solid interface**
 - , diffuse, growth, 707
 - , ledged, 1410 ff
 - , local equilibrium, 683 ff
 - , non-planar, 720
 - , planar, 714 ff, 720 ff
 - , shape, 714 ff
 - , sharp, growth, 704 ff
 - , structure, 702 ff
 - in ternary alloys, 754
 - : macrosegregation, *see* "Macrosegregation"
 - : microgravity, effect of, 821 ff
 - : microsegregation, *see* "Microsegregation"
 - : miscibility gap, 771 ff
 - , monotectic, 483, 771 ff
 - , directional solidification, 773 ff
 - : morphological (in)stability of planar liquid-solid interface, 720 ff, 726
 - : cellular structures, 725 ff
 - : effect of fluid flow, 729 ff
 - : experiments, 725 ff
 - : microsegregation, *see* "Microsegregation"
 - : non-equilibrium freezing
 - : no solid diffusion, 715
 - : partial mixing in liquid, 718 ff
 - : nucleation of solid, 687 ff, 1756 ff
 - : partition coefficient, 683, 728
 - , dependence on interface velocity, 710
 - , partitionless, 737
 - , peritectic, 775 ff
 - , aligned, 778
 - : porosity, 793 ff
 - , powder, 679 ff
 - : predendritic nuclei, 673
 - , rapid, 771, 775, 779 ff, 820 ff, 1724, 1748 ff, 2544 ff
 - , **rapid, practical methods**, 820 ff, 1725 , 1748 ff
 - , atomization, 820, 1748
 - , chill methods (including melt-spinning, melt extraction, etc.), 677 ff, 821, 1748 ff
 - : consolidation, 1752
 - : cooling rates in, 1752 ff

- : crystalline alloys, *see* "RSP crystalline alloys"
- : plasma spraying, 1749
- : pseudo-RSP, 1758
- : self-substrate methods, 1759 ff
- : spark-erosion, 1752
- : splat-quenching, 1748
- : surfaces, 1759 ff
- rates, direct measurement, 1761 ff
- : response functions, 709 ff
- : rheocasting, 826 ff, 829
- : solid diffusion during freezing, 716 ff
- : solidification path, 754
- : solute-trapping, 685, 712, 770
- : subdivided melt method, 693 ff, 1756 ff
- , ternary alloys, 752 ff
- : thermodynamics, 682 ff
- , weld zone, *see* "Welding"
- Solid solubility**, 136 ff, 145, 150 ff, 485 ff
- Solid solutions**, 136 ff
 - , aluminum-base, 182 ff
 - , atomic size in, 154 ff, 159 ff
 - : classification, 138 ff
 - : creep, 1969 ff, 2040 ff, 2064 ff,
 - : deformation twinning, 2031 ff
 - , dislocation motion in, 1896
 - : electronegativity influence, 108, 114 ff, 147, 161
 - : electron phases, 108 ff, 111, 166 ff, 170, 225
 - : fatigue, 2043, 2346 ff
 - : hardening, *see* "Hardening"
 - , Henrian, 485
 - , inhomogeneous, thermodynamics, 1481
 - , interstitial, 139, 1561 ff
 - , **iron-base**, 1561 ff
 - : solubility of carbon in iron in equilibrium with different phases, 1562 ff
 - : solubility of nitrogen in, 1564
 - : lattice spacing in, 180 ff
 - : mechanical properties, 2010 ff
 - : noble-metal based, 180 ff
 - : ordered, 121, 193 ff, 198 ff, 252 ff
 - : recovery (microstructural), 1979
 - : size effect influence, *see* "size factor"
 - : solubility prediction, 346
 - : stacking faults in, 191
 - : thermodynamic properties, analysis, 496 ff
 - , excess properties, 496
 - , optimization, 496 ff
 - : transition-metal based, 154
 - : Vegard's law, 164, 330 ff
- Solid-state amorphization reactions**, 1764 ff
- Solid-state chemistry of intermetallic compounds**, 206 ff
- Solidus**, 473
- Solute drag**, 1396 ff, 1478, 1866 ff, 1970 ff, 2018, 2440 ff
 - , dilute solid solutions, 2019
 - , concentrated solid solutions, 2019 ff
- Solute pumping**, 895
- Solute-trapping**, 685, 712, 770, 1744
- Solution-softening**, 2035 ff
- Solutions**,
 - regular, 439 ff
 - , thermodynamics of, 435 ff
 - , activity in, 438
- Sonochemical method of making amorphous iron**, 1763 ff
- Sonoluminescence**, 1763
- Space group symbols**, 5 ff
- Spallation maps**, 1306
- Spectrometry**
 - : Auger-electron, 989, 1212
 - : electron energy loss, 1087, 1091 ff, 1217 ff
 - : ion-scattering, 1214 ff
 - : photon probe techniques, 994 ff
 - : positron-annihilation, 175, 1633, 1636 ff, 1681
 - : secondary-ion mass, 1215 ff
- Spark-erosion**, 1752
- Sphere packing**, 7 ff
- Spheroidization of cylindrical inclusions**, 880 ff
- Spin waves**, 2549
- Spinodal alloys**
 - : magnetic properties, 2516 ff
- Spinodal**
 - : coarsening (late) stage, 1486, 1489
 - , coherent, 1484
 - , conditional, 1493
 - : decomposition, 1167 ff, 1175 ff, 1369 ff, 1480 ff, 1581, 2055
 - : fastest-growing wavelength, 1483
 - : role of thermal fluctuations, 1485
- Splat-cooling**, *see* "Solidification, rapid"
- Stability diagrams**, *see* "structure, maps"
- Stacking fault(s)**, 189 ff, 1846 ff
 - , complex, 1850 ff, 2083
 - energy, 189
 - in fcc solid solutions, 2030 ff
 - in two-phase alloys, 2046
 - , extrinsic, 190, 1848
 - , intrinsic, 190, 1846
 - in $L1_2$ phases, 2086 ff

- , measurement, 190 ff
- : (in) solid solutions, 191, 1074
- tetrahedra, 1066, 1839, 1848
- , superlattice extrinsic, 2099, 2150
- , superlattice intrinsic, 2088, 2149
- , twin growth, 190
- Standard molar Gibbs energy, 485
- Standard state, Henrian and Raoultian, 442
- Steels**, 1556 ff (*see also "Iron"*)
 - : alloying elements, important, 1557
 - : ausforming, 1609 ff
 - : austenite grain size (prior), 1605 ff
 - : austenitic, 1568, 1610 ff
 - : bake-hardening, 1597
 - : brittleness,
 - : caused by impurity segregation, 1270 ff, 1275 ff, 1281, 1582, 1612
 - : carbides in, 1563 ff, 1569
 - : continuous casting, 799 ff
 - : copper in steels, 1601
 - : deformation, 1583 ff
 - : dual-phase, 1601 ff
 - (for) electrical applications, *see "Silicon steels"*
 - : ferritic, 1568
 - : hardenability, 1578 ff
 - : heat treatment, 1577 ff
 - : high speed, 1610
 - : high-strength low-alloy, 1600 ff
 - : hydrogen embrittlement, 1279, 2217 ff, 2282 ff
 - : intercritical annealing, 1601
 - : interstitial-free, 1594 ff, 1615
 - : iron–carbon phase diagram, 1565
 - : killed, 1615
 - : low-temperature, 1611 ff
 - : magnetic properties,
 - : manganese in, 1568
 - : maraging, 1607 ff
 - : martensitic transformation, *see "Martensitic transformation"*
 - : mechanical properties, 1589 ff
 - : microstructure, 1573, 1575, 1577, 1600
 - (for) nuclear applications, 1613 ff
 - : for fusion reactors, 1614
 - : pearlite, 1564, 1570 ff
 - : prior austenite grain boundaries, 1582
 - : rapidly quenched, 1594, 1809 ff, 1814 ff
 - : *r* value, 1596
 - : recovery, 1587
 - : recrystallization, 1587 ff, 2470
 - : recrystallization-controlled rolling, 2455
 - , rimming, 1615
 - : solidification, 1615 ff
 - : solid–solution hardening, 1593 ff
 - : solute partitioning, 1456
 - : stabilization of austenite, 1575
 - , stainless, 1611
 - , fatigue, 2353
 - : strain-aging, 1596 ff
 - : strength ranges in different types of steel, 1591
 - , structural, properties of, 1594 ff
 - , super-clean, 1613
 - : tempered martensite embrittlement, 1582 ff
 - : temper embrittlement, 1270 ff, 1281, 1612, 2285 ff
 - : thermo-mechanical treatment, 1609 ff
 - : tool steels, 1610, 1794, 1815
 - : transformation diagrams, 1577 ff
 - : transformation reactions, 1570 ff
 - : transformer, *see "Iron–silicon"*
 - : ultra-high-strength, 1607 ff
 - : ultra-low-carbon, *see "interstitial-free"*
 - Stereology**, *see "Quantitative metallography"*
 - Stokes–Einstein relationship**, 1798
 - Stoner criterion**, 124
 - Strain hardening**, 1862, 1913 ff, 2049, 205 (*see also "Stress–strain curves"*)
 - of alloys with small particles, 2115 ff
 - of metal–matrix composites, 2592 ff
 - Strain localization**, 1949
 - Strain rate, effective**, 2003 ff
 - Strain softening**, 1939 ff
 - Stress–corrosion cracking, intergranular**, 1276 ff
 - Stress relaxation**
 - : dispersed-phase and precipitation-strengthened alloys, 2126 ff, 2179 ff
 - in metal–matrix composites, 2594
 - in polymers, 2728
 - , used to determine activation volumes for plastic deformation, 2180
 - Stress–strain curves**, 1915 ff, 2010 ff
 - : bcc crystal,
 - : Considère's criterion, 2694 ff
 - : critical (resolved) shear stress, 1885 ff, 1926
 - , cyclic, 2300 ff, 2308 ff
 - compared with monotonic deformation, 2336 ff
 - : easy glide, 1915 ff
 - : fcc crystals (solid solutions), 2011 ff, 2023 ff
 - : dynamic recovery, 2030
 - : effect of temperature, 2012, 2021 ff
 - : linear hardening, 2029 ff

- : hcp metals, 1916
- : latent hardening, 1932
- , metal-matrix composites, 2603
- , multiphase alloys, 2113 ff
- : polycrystals, 1940 ff
 - , relation to stress-strain curves of single crystals, 1943 ff
 - : Sachs average, 1942
 - : Taylor factor, 1942 ff
 - : Taylor model, 1943
- , rubbers, 2739 ff
- : stage I, 1915 ff, 1926, 2113
- : stage II, 1916 ff, 1926 ff, 2029 ff, 2113
- : stage III, 1916 ff, 1929 ff, 2113
 - , solid solutions, 2012, 2030
- : stage IV, 1917 ff, 1930 ff
- : stage V, 1917 ff
- , superalloys, 2146
- : theoretical models, 1924 ff
- , true, 2694
- , two-phase alloys, 2112 ff, 2127
- Stretcher strains**, 1597
- Structure (crystal)**
 - , alternative graphical representations, 218
 - : axial ratio, *see "Axial ratio"*
 - , binary alloy phases, 102 ff
 - , intermetallic compounds, 206 ff, 2141 ff
 - maps, 102 ff, 345 ff
 - : nomenclature, 13 ff
 - , prediction, 2
 - : simple metals, 2 ff, 95 ff
 - : size-factor influence, *see "Size factor"*
 - , silicon, 99 ff
 - : stability
 - , elemental metals, 95 ff, 488
 - : valence effect, *see "Valence compounds"*
- Strukturbericht symbols**, 226 ff
- Subgrain(s)**
 - boundaries, *see "Creep"*, "Dispersed-phase alloys" and "Recovery from deformation"
 - coalescence, 2435 ff
- Sulphides at surfaces**, 1311 ff, 1318 ff
- Superalloys**, 2142 ff
 - : coalescence of the precipitates, *see "rafting"*
 - , deformation mechanisms, 2147 ff
 - , dislocations in, 2048
 - : duplex structures, 2165
 - , grain-size effects, 2168 ff
 - , dependence on γ' fraction, 2172
 - : micromechanisms of plasticity, 2190 ff
 - , microstructure, 2076
 - : multiphase precipitation hardening, 2165 ff
 - : persistent slip bands,
 - : plasticity of the γ matrix, 2196 ff
 - : dislocations in matrix corridors, 2200 ff
 - : rafting, 2157 ff, 2182, 2201 f
 - , rapid-solidification processed,
 - : resistance to coarsening, 878
 - : secondary recrystallization,
 - : single-crystal plasticity at intermediate temperatures, 2198 ff
 - , stress-strain curves, 2146
 - , temperature dependence of flow stress, 2147
- Supercooling**, *see "Undercooling"*
- Superdislocation**, 2056 ff
- Superelasticity**, 1541
- Superlattice (superstructure)**, 140, 248 ff
 - , long-period, 195 ff
 - , semiconducting, 902 ff
 - stacking faults, 22088, 2099, 2149 ff
 - types, 194 ff
- Supermalloy**, 2536
- Superparamagnetism**, 2513
- Superplasticity**, 1997 ff
 - mechanism, 1998 ff
 - of nanocrystalline ceramics, 928 ff
- Supersaturation**, 1377
- Surface**
 - analysis techniques, 1211 ff
 - concentration, 453 ff
 - diffusion, 626 ff, 977 ff
 - : effect of adsorbed elements, 1254
 - enrichment ratios, measured and predicted, 1229
 - free energy, 1210
 - as affected by segregation, 1249 ff
 - microchemistry, 1202 ff
 - premelting, 978
 - protection, 1292 ff
 - segregation, 454, 1202 ff, 1225 ff
 - : correlation with grain-boundary segregation, 1240 ff
 - structure, 626 ff, 977 ff
 - by X-ray diffuse scattering, 1139
 - tension, 456
 - : thermodynamics, 453 ff
- Surfaces, rapid solidification processing**, 1759 ff
- Synchro-shear**, 2151
- Synchrotron radiation (X-ray) sources**, 1121, 1123, 1169 ff

- T**antalum-rhenium alloys, 2035
 Taylor factor, 1942, 2345 ff
 Taylor lattice, 2314 ff, 2317
 TD (thoria-disperse) nickel, 2109, 2139 ff, 2160
 Tellurium
 – crystal structures, 26 ff, 38
 Temper-brittleness, 1270 ff, 1281, 1612
 Tempering of martensite, 1579 ff
 Tensile deformation, *see* "Plastic deformation"
 Ternary composition triangle, 503 ff
 Textures (*see also* "Mesotextures")
 – annealing, *see* "Annealing textures"
 – casting, 784
 –, deformation, 1943 ff, 2455, 2459
 –: orientation functions (polymers), 2680 ff
 –: orientation distribution functions, 2456
 – (of polymers, 2676 ff
 – (and) r value, 1596
 –: secondary recrystallization, 2486 ff
 –, wire-, in metals, 2675 ff
 Thermal cycling, 884
 Thermal expansion of metal-matrix composites, 2609 ff
 Thermal gradients, 612 ff, 883 ff
 Thermobalance, recording, 1327
 Thermobaric quenching, 1768
 Thermochemistry, metallurgical, 417 ff
 Thermodynamics,
 –: ideal behavior, 442
 –, laws of, 414 ff, 419
 –, metallurgical, 414 ff
 – of irreversible processes, 539
 Thermomechanical treatment of steels, 1609 ff
 Thermomigration, 611 ff, 615
 Thixocasting, 829
 Thompson tetrahedron, 1846
 Thomson-Freundlich equation, 460
 Thorium
 – crystal structure, 39
 Threshold stress, 2185 ff
 Tie-line, 473
 Tight-binding approximation, 64, 77
 Tilt boundary, 1078, 2413
 – mobility, 2415
 Time-temperature-transformation diagrams
 –: steel, 1455 ff
 Tin
 – crystal structures, 25, 35
 –: unusually large atomic radius, 25
 Titanium
 –: allotropy, 19 , 24
Titanium aluminides
 –, dislocation cores in, 2099 ff
 –: phase equilibria, 2095 ff
 –: TiAl, mechanical properties, 2093 ff
 –: TiAl/Ti₃Al two-phase alloys, 2094 ff
 ---: two-phase 'single crystals', 2096 ff
 T_o curves, 686 ff
 Tool steels, *see* "Steels"
 Topochemical investigative techniques, 989
 Toughness, 2213 , 2238
 Trace elements, 1202 ff
 Transformation-toughening, 2286 ff
Transformations in the solid state (*see also* "Precipitation")
 –, athermal, 1508
 –: charge-density waves, 1548 ff
 –, continuous, 1451, 1480 ff
 –, (of) highly defective phases, 868
 –, diffusive, 1364 ff
 –, discontinuous, 1451, 1456 ff
 ---: lamellar spacing in, 1460 ff
 –, displacive, 1364, 1532 (*see also* "Martensitic transformation")
 --: diffusional-displacive, 1545
 –, driving forces, 1365 ff
 –, eutectoidal, 1451 ff
 –: experimental techniques, 1372 ff
 –, first-order, 1371
 – growth, *see* "Growth"
 –, higher-order, 1371
 –, incommensurate, 1549 ff
 – involving long-range diffusion, 1400 ff, 1418 ff
 –, irradiation-induced, 643, 1709
 –, martensitic, *see* "Martensitic transformation"
 –, massive, *see* Massive transformation"
 –, nondiffusive, *see* "Martensitic transformation"
 –, microstructural, 866 ff
 –: nucleation, *see* "Nucleation"
 –: (associated) plasticity, 1880 ff
 –: problems, outstanding, 1495 ff
 –: precursor phenomena, 1140 ff
 –: recrystallization reactions, 1379
 –, reconstructive, 1364, 1532
 –, spinodal, *see* "Spinodal"
 – (in) steels, 1570 ff
 –, thermoelastic, 1527 ff
 – toughening, 2286 ff
 Transformation-induced plasticity, 1536 ff
 Transformation diagrams, 1577 ff
 –, continuous-cooling, 1578
 –, isothermal, 1578 ff

- Transformer steel, *see* "iron–silicon"
- Transition bands, 2432 ff (*see also* "Deformation bands")
- Transition metals**
- : atomic sphere approximation, 79
 - : atomic radii and volumes, 15 ff, 18, 94
 - : band structure, 77 ff
 - : bulk properties, theory, 90 ff
 - : cohesive energy, 93 ff
 - : crystal structures, 18 ff, 99 ff
 - : energy levels, 55
 - : heats of formation, calculation, 112
 - : hybrid bands, 82 ff
 - : intermediate phases based on, 178 ff
 - : lattice spacings in solid solutions, 184 ff
 - : magnetic properties, theory, 122 ff
 - : solid solutions based on, 154
 - : valence states of, 149
 - : Wigner–Seitz radius, 94
- Transmission electron microscopy**, 1034 ff
- : analytical, 1086 ff
 - : beam-spreading, 1090
 - : electron energy loss spectrometry, 1087, 1091 ff, 1217 ff
 - : error correction, 1090 ff
 - : thin-film approximation, 1089 ff
 - : spatially resolved valence electron energy loss spectrometry, 1112
 - : bend contours, 1049
 - : bright-field image, 1036
 - : charge-coupled device cameras, 1111
 - : convergent-beam diffraction, 1040 ff, 1111
 - : dark-field image, 1036
 - : diffraction contrast, theory, 1042 ff
 - : dislocations
 - imaging, 1056 ff
 - : Burgers vector, determination, 1061 ff
 - : dipoles, 1059 ff
 - : dislocation density, determination, 1062
 - : dislocation distribution, 1921 ff
 - (of) dislocations in fcc alloys, 2014 ff
 - : dislocation-particle interaction, 2047 ff
 - : *g.b* product, 1057 ff, 1063
 - : loops, 1063 ff
 - : strain contrast, 1054 ff
 - : superdislocations, 1110
 - : double diffraction, 1038 ff
 - : dynamical diffraction theory, 1044 ff, 1052 ff
 - : absorption, normal and anomalous, 1046 ff
 - : column approximation, 1050
 - : image intensities, 1047 ff
 - : Pendellösung, 1047
 - : thickness contours, 1047 ff
 - : electron energy loss spectrometry, *see* "analytical"
 - : excitation error, 1044
 - : extinction length, 1044
 - : field-emission guns, 1035
 - : foil thickness measurement, 1042, 1090
 - : Fraunhofer diffraction, 1096
 - : grain-boundary images, 1075 ff
 - : high-resolution, *see* "High-resolution electron microscopy"
 - : imperfect crystals, diffraction, 1050 ff
 - : instrumentation advances, 1110
 - : interface, heterophase, imaging, 1078 ff
 - : interface, translational (faults, antiphase boundaries), 1072 ff
 - Kikuchi lines, 969, 1040
 - : kinematical diffraction amplitude, 1099 ff
 - : kinematical diffraction theory, 1051, 1094 ff
 - : Moiré patterns, 1042
 - : ordered crystal patterns, 1039 ff
 - (applied to) phase transformations, 1373
 - : precipitates, imaging, 1067 ff
 - black-and-white contrast, 1068
 - coffee-bean contrast, 1068
 - matrix contrast, 1068
 - structure-factor contrast, 1069
 - : resolution, 1034 ff
 - : scanning (STEM) mode, 1037, 1217
 - : strain contrast, 1042, 1054
 - : strong-beam image, 1054
 - : void imaging, 1066
 - : weak-beam image, 1044
- Tresca criterion, 2698
- Triple point, 424, 450
- Trouton's rule, 420
- TTT diagram, *see* "Time-temperature-transformation diagrams"
- Twin**
- , annealing, 897
 - (in) bcc metals, 2479
 - , formation, 2477 ff
 - boundary, 1872
 - , mechanical,
 - (in) ordered alloys, 2065 ff
 - , transformation-, 1517 ff
- Twinning**
- , deformation, 1907 ff, 2031 ff
 - (in) ferritic steels, 1587
 - crystallography, 1911
 - nucleation, 1910

- , multiple, 2439
- (in) ordered alloys, 2065 ff, 2096 ff, 2151 ff
- : polysynthetically twinned crystals, 2096 ff
- : recovery-twins, 2438
- Two-phase alloys, *see* 'Dispersed-phase alloys' and "Hardening, precipitation"**

- U**ltimate tensile strength, Undercooling, 694, 697, 1377
 - , constitutional, 721
 - , formation of metastable phases by, 699 ff, 1729 ff
 - (in) precipitate growth, 1399
 - : solidification at high undercoolings, 1756 ff
- Uranium**
 - polymorphism, 39

- V**acancy(ies), 1623 ff
 - agglomerates, 1642 ff, 1703
 - : atomic relaxation around, 1624
 - concentration, thermodynamics of, 437 ff
 - concentration, determination of, 1627 ff
 - , constitutional, 186 ff, 600
 - (from) dislocation intersection, 1905
 - , divacancies, 1643
 - , binding enthalpy, calculation, 1627
 - : differential dilatometry, 1627 ff
 - : electrical resistivity per vacancy, listing, 1629 ff
 - : enthalpy of formation,
 - , calculation, 1623 ff
 - , experimental determination, 1626 ff
 - , listing, 1629 ff
 - : entropy change,
 - , calculation, 1623 ff
 - , experimental determination, 1626 ff
 - , listing, 1629 ff
 - : (in) grain boundary, 2450 ff, 2632
 - interaction with solute atoms, 1644 ff
 - interstitial interaction, 1651 ff
 - : close pairs, 1653
 - lattice, 894
 - migration
 - , activation enthalpy, 1635 ff, 1639 ff
 - (in) ordered alloys, 1646 ff
 - : positron-annihilation spectroscopy, 1633
 - : properties, listing, 1629 ff
 - , quenched-in, 1169 ff
 - relaxation volume, 1625, 1628
 - , listing, 1629 ff
 - W**agner–Lifshitz–Slyozov theory of Ostwald ripening, 873 ff, 1437 ff
 - Warren–Cowley parameters**, 1145 ff
 - Water**, phase diagram, 425 ff
 - Wave function**, 51
 - Welding**, 803 ff
 - : fusion zone, 803 ff
 - : heat-affected zone, 804 ff
 - : macro- and microstructure, 807 ff
 - : solidification rate, 807 ff
 - Widmanstätten precipitates**, 1389, 1405, 1396, 1416, 1418, 1431, 1470
 - , coarsening, 1448 ff
 - : Widmanstätten ferrite, 1571
 - , formation kinetics, 1474 ff
 - , dissolution, 1433
 - Wigner–Seitz**
 - , cell, 76
 - , theory of bonding, 48 ff, 76 ff, 88
 - , radius, 76, 86 ff, 88
 - Work hardening, *see* "Strain hardening"**
 - Work softening**, 1939 ff
 - Wulff construction**, 1382
 - Wulff plane**, 1381 ff
 - Wyckoff sequence (for crystal structures)**, 224

 - X-ray absorption and scattering**
 - : absorption coefficients, 1120 ff
 - : absorption edge, 1121
 - : angle of total reflection, 1131

- : Bragg peak broadening, 1132 ff
 - : Bragg peak intensity (and changes), 1118 , 1132 ff
 - : Bragg peak shifts, 1130 ff
 - : Compton scattering, 112
 - : detectors, 1130, 1139
 - : diffuse scattering, 1118 ff,
 - between Bragg peaks, 1139 ff (*see also* "monotonic Laue scattering")
 - components, 1148 ff
 - near Bragg peaks, 1134 ff
 - (due to) point defects, 1664 ff
 - : extended X-ray absorption fine (EXAFS), 1183, 1777
 - : fluorescence, 1121
 - : Hönl corrections, 1121
 - : Huang scattering, 1135 ff, 1147, 1665, 1673 ff
 - : inelastic scattering, 1126 ff
 - , coherent, 1126
 - , incoherent, 1127 ff
 - : isomorphous and isotopic substitution, 1771 ff
 - : line broadening due to plastic deformation, 1924
 - : pair distribution function, 1769 ff
 - : phonon role in inelastic scattering, 1126
 - (from) point-defect clusters, 1136 ff
 - : peak shifts due to plastic deformation, 1924
 - : radial distribution function, 1770
 - : scattering, 1116 ff
 - : single-particle scattering function,
 - : size-effect scattering, 1132 ff
 - : small-angle scattering, 1161 ff (*see also* "Small-angle scattering...")
 - : spurious radiation,
 - : surface sensitivity, 1131 ff
 - : thermal diffuse scattering, *see* "diffuse scattering"
 - : X-ray photoelectron spectroscopy, 1213 ff
 - : X-ray sources, 1121, 1128 ff
 - : X-ray topography, 988
 - : Zwischenreflex scattering, 1139
-
- Y**ield anomaly, *see* "Anomalous flow behavior in L1₂ phases"
 - Yield, discontinuous (yield phenomenon)**
 - in fcc solid solutions, 2028 ff
 - in lithium fluoride, 1938 ff
 - in non-ferrous metals, 1939, 1941
 - in polymers, 2695 ff
 - in semiconductors, 1938
 - in steels, 1585 ff, 1596 ff, 1869, 1938, 2053 ff
 - (due to) strain softening, 1939 ff

Yield stress

- (in terms of) continuum mechanics (yield criteria), 1946 ff
 - : Mohr diagram, 2129 ff
 - : (for) polymers, 2698 ff, 2709
 - : von Mises condition, 1946, 2590, 2698
 - : Tresca criterion, 2698
- : critical resolved shear stress for glide, 1885 ff
- : dependence on cell (subgrain) size, 1930 ff, 1981, 1984, 2416
- : dependence on dislocation density, 1925
- : dependence on grain size, 2168 ff (*see also* "Hall-Petch relationship")
- : dependence on mesh length, 1923
- : dependence on order, 2059 ff
- : Fleischer-Friedel theory, 1903
- : forest dislocation cutting, 1903 ff
- : Labusch, 2020
- : mechanisms determining, 1894 ff
 - , extrinsic, 1896 ff
 - , intrinsic, 1894 ff
- : metal-matrix composites, 2584 ff
- : particle resistance, 1897 ff
- : of polymers, 2693
- : solute resistance, 1896
- : superposition of different resistances to plastic deformation, 1905 ff
- : threshold stress, 2185 ff

Young's modulus, 1880

- Z**ener relationship, 1009, 2159, 2467 ff. 2642
- Zener relaxation, 567 ff
- Zero creep technique, 1210, 2630
- Zinc, recovery from deformation, 2401 ff
- Zinc group metals
 - crystal structures, 21 ff
- Zintl phases, 225 ff
- Zirconium
 - purification by electromigration, 619
 - : fast diffusion, 595
 - : allotropy, 20, 24
- Zone-hardened Al-Cu alloys, 2051
- Zone-melting (zone-refining), 719 ff
- Zone-refined iron, 1588



The late Prof. Peter Haasen

Colour picture on front cover:

Simulation of an alloy dendrite growing into a supercooled liquid using the phase-field method. The colours show variation of composition (atomic fraction Cu) in the liquid and solid for parameters approximating a Ni-Cu alloy with 0.41 atomic fraction Cu. See ch. 8, par. 7.5
(Courtesy of William J. Boettinger and James A. Warren).