

Index

a

- ab initio* method 448
- ab initio* molecular dynamics (AIMD) 456
- absorb-contrast imaging (ACI) 635–643
 - breast cancer metastasis 642
 - cerebral vascular disease
 - collateral circulation detection 638
 - functional angiogenesis 640
 - microvessel function detection 638, 640
 - middle cerebral artery occlusion (MCAO) evaluation 636–638
 - small intracranial arteries, direct visualization of 638
 - subarachnoid hemorrhage (SAH) 641
 - diabetes research 641
 - hepatocellular carcinoma detection 643
 - hypertension research 641–642
 - spinal cord vasculature 643
- absorption correction factor (ACF) 360
- accelerator driven systems 399
- actinides 391, 392
 - in aqueous solution 410, 418
 - with borohydride anion 393
 - carbonate complexes 453
 - complexes under high pressures 461
 - complexes with organic ligands 454–455
 - dissolved in ionic liquids 406–409
 - dissolved in organic solution 418–419
 - EXAFS 398–400, 404, 420, 439, 448–457
 - extracted into organic solution 419–420
 - extraction with ionic liquids 409–410
 - under high pressures 460–461
 - hydrate complexes 449–452
 - hydroxide complexes 452
 - in situ* experiments 395–398
 - ionic liquids 404
 - materials under high pressures 460
 - materials with HEXS 462, 464
 - measurements 393–398
 - metals under high pressures 460
 - with microorganisms 434–439
 - minerals interactions 420–421
 - molten salts 404–406, 410
 - with nuclear fuels 398–400
 - with nuclear waste disposal 400–402
 - in organic solutions 418, 420
 - oxidation state and coordination number 391
 - oxides and nitrides under high pressures 460–461
 - phonon dispersion properties of 466
 - plutonium 391
 - radiation protection standards 393–395
 - RXS for 465–466
 - SAXS for 464–465

- actinides (*contd.*)
- solid-state complexes 455–456
 - solutions 463, 464
 - structural analysis of 402–404
 - structural chemistry of 410, 420
 - XAFS 398, 439
 - XANES 439–448, 457
- actinyl AnO_2^+ ions 391
- active layer morphology
- GISAXS 215–223
 - GIWAXS 204–215
- Advanced Photon Source (APS) 102
- ambient pressure photoelectron spectroscopy (AP-PES)
- CO oxidation over Pd(100) 517–519
 - electrochemical process, liquid/solid interfaces in 527
 - instrument development 514–517
 - PEM 523–525
 - SOC 520–523
 - working principles 515
- americium 418
- amplitude energy oscillation 14
- angle-dispersive X-ray diffraction (ADXRD) 460
- angle-resolved photoemission spectroscopy (ARPES) 109–111
- anionic lipid–DNA (AL–DNA) complexes 726
- annular dark-field (ADF) 280
- anomalous scattering 62
- 9,10-anthrahydroquinone-2,6-disulfonate (AH2QDS) 437
- anthraquinone-2,6-disulfonate (AQDS) 446
- area detector 62, 63, 65, 67, 68, 112
- Arg-Gly-Asp peptides conjugated magnetite nano-clusters (RGD-MNCs) 646
- atomic force microscopy (AFM) 193, 259
- atomic multiplet theory 466
- atomic pair distribution function (PDF) 68
- attenuation length 124, 126
- Auger decay process 140
- Auger electrons 124, 127
- Auger fractional intensity 142
- Auger spectrum 160
- autocorrelation function 182, 184, 243, 244, 246
- autoionization process 141
- AXES server 665
- b**
- bandpass frequency filter 240
- band splitting 255
- basis-set supported SAXS (BSS-SAXS) approach 670, 671
- beam emittance 56
- bending magnet 36, *see also* dipole magnetscurvature radius of electromagnetic radiation 36 radiation 2–4, 8
- bending radius 2
- 1,4-benzenediamine (BDA) 151
- benzodifurandione-based poly(*p*-phenylenevinylene) (BDPPV) 94
- Bessel function 4, 6
- beta functions 12
- biaxial tensile strain effects 255
- bilayer geometry 192, 193
- binding energy 329
- 2,6-bis(2-benzimidazolyl)pyridine (BBP) 472
- BL01B1 39, 40
- Bragg angle 48, 49
- Bragg condition 39, 66, 99
- Bragg-diffracted X-ray plane 66
- Bragg diffraction 68
- Bragg geometry 52
- Bragg geometry CDI (BCDI) 249–254
- Bragg peaks 200, 205–207, 209, 212, 213, 249, 258
- Bragg ptychography measurements 258
- Bragg reflection 211, 219, 261
- Bromide surface segregation 345
- Brownian motion 185
- bulk heterojunction (BHJ) geometry 192, 193, 288

C

- calcite 429–430
- calcium silicate hydrates 402
- carbon and Si nanostructures
 - energy applications of 276–277
- carbon nanofiber (CNF) 281
- carbon nanomaterials 285, 288
- carbon nanostructures
 - catalyst 289–292
 - fuel cell 280–284
 - Li-ion battery 284–288
 - solar cell 288–289
- carbon nanotubes (CNTs) 275, 602
 - electronic structure of 279
 - hollow structure of 289
 - vs. NPs 290
- cathode material 82–83
- cationic lipid–DNA (CL–DNA)
 - complexes 726, 727
- cellular imaging
 - environmental scanning electron microscopy 567
 - existing microscopy 566–568
 - fluorescence microscopy 567
 - immunolectron microscopy 567
 - Raman spectroscopy 567, 568
 - synchrotron-based X-ray microscopy 568–572
- cellular localization 438
- CeO₂ NPs 611, 615, 616
- charge coupled device (CCD) detector 261
- charge transfer dynamics 142
 - organic/electrode interfaces 148–165
 - self-assembled monolayers on metal substrates 159–163
 - through-space within π coupled molecules 164
- charge transfer times 142–143
 - chemisorbed organic molecule on metal 150–152
 - electrons tunneling 152–155
 - molecular orientation and orbitals 152
 - molecular orientation and site dependence 156–159
 - organic molecules and metal oxide substrates 155–159
 - organic semiconductor and metal substrates 148–165
 - physisorbed organic molecule on metal 148–150
 - timescale between organic dyes and TiO₂ substrates 155–156
- Chasman–Green(CG) structure 19
- Chervine-type DAC 396
- chromatic effect 13
- circular dichroism (CD) 692
- circular polarization 38, 39
- circularly/elliptically polarized radiation 6
- citrate-capped gold nanoparticles 616
- classical molecular dynamics (CMD)
 - simulations 456
- clay minerals 425–427
- closed orbit 10, 12
- Cohen–Fano oscillations 334
- coherent diffractive imaging (CDI) 565, 566
- coherent flux 248
- coherent X-ray diffraction imaging (CDI) 239
 - BCDI 249–254
 - fundamental concepts of 241–243
 - phase retrieval 243–246
- coherent X-ray scattering 62
- cold target recoil ion-momentum spectroscopy 325
- collimator mirror 42
- COLTRIMS technique 335
- compound refractive lenses (CRLs) 38, 55
- compressed sensing (CS)
 - algorithm-based micro-CT 364
- Compton scattering 67
- computed tomography (CT) 100
- computer linked fixed-exit DCM 51
- COMSOL Multiphysics software 263
- COMSOL-simulated displacement 262
- conditional probability 142
- conduction band 143

- conductor-like polarizable continuum model (CPCM) 452
 - conductor-like screening model (COSMO) method 451
 - confocal SR- μ -XRF 470–471
 - confocal synchrotron radiation micro X-ray fluorescence 394
 - conjugated polymers 201
 - P3HT 209
 - contrast transfer function (CTF) 760
 - conventional X-ray imaging 634
 - copper nanoparticles (Cu NPs) 607
 - core-level XPS 343
 - core-hole clock (CHC) spectroscopy 138
 - charge transfer times 142–143
 - dynamic charge transfer, energetic condition for 143–145
 - measurements 147
 - OMBD 145–146
 - organic/electrode interfaces 145–147
 - photoexcitation
 - excitation–deexcitation processes 139–142
 - principles of 139–143
 - self-assembled monolayers (SAMs) 146, 147
 - Cornell-type 396
 - correlated imaging 102–103
 - Coulomb interaction 144, 192
 - critical angle 196, 197, 216, 217
 - total reflection 54
 - critical photon energy 3, 8
 - critical temperature 403
 - cryo-electron microscope (cryo-EM) 717
 - CRY SOL program 662–665
 - crystal diffraction 39
 - crystal interferometer imaging 98–99
 - crystal monochromators 44, 47–54
 - crystal truncation rods (CTR) 62, 65–66
 - Curie temperature 180–183, 189
 - curium 418
 - cut-off frequency 36
 - cyclic frequency 36
- d**
- DAMMIN method 666
 - Daphnia magna* 608
 - data-constrained modeling (DCM) 362, 363
 - data reduction technique 459
 - DCM, *see* data-constrained modeling (DCM)
 - Debye–Buche correlation function 215
 - Debye formula 657, 659, 662, 663, 670
 - Debye–Hückel theory 699
 - Debye–Scherrer-like rings 200
 - Debye–Waller factors 73
 - deflection parameters 5
 - density functional theory (DFT)
 - approach 449
 - calculations 332
 - method 452, 455
 - density of states (DOS) 255, 277
 - depth of focus (DOF) 763
 - diamond anvil cells (DAC) 396
 - differential-aperture X-ray (structural) microscopy 69
 - diffraction enhanced imaging 99
 - diffraction geometry 53
 - diffraction intensity distributions 251
 - diffraction-limited value 18
 - diffraction patterns 62
 - diffraction-reflection technique 65
 - diffuse scattering 197, 198
 - digital subtraction angiography (DSA) 635
 - dipole magnets 2, 3, 8, 10, 15, 16, 19–20
 - direct wafer bonding 258
 - dissimilatory metal-reducing bacteria (DMRB) 438
 - distorted wave born approximation (DWBA) 197
 - DNA-functionalized nanoparticles 689
 - aptamers and DNazymes 712
 - autoimmune diseases 704–706
 - counterion distributions 699–700, 702
 - cryo-TEM analysis 717

- G-quadruplexes 711
 - i-motif structures 712
 - lipid interaction 725–727
 - metal-binding sites 695, 698
 - metal–nucleic acid complexes 695–697
 - multivalent ions 701–702
 - osmotic pressure effects 703–704
 - polyelectrolyte electrostatics 700–701
 - polypod-like structures 712
 - surface-bound nucleic acids 694–695
 - synchrotron footprinting, 713–716
 - 3D assemblies 716, 718–725
 - DNAzymes 688, 696, 712
 - dodecanethiol addition 79
 - donor–acceptor interface 192, 193, 221
 - Doppler broadening 327, 328
 - Doppler effect 327, 336
 - Doppler-marker 336
 - Doppler micro-ultrasonography 635
 - double-bend achromat (DBA) 10, 21, 22
 - double-crystal monochromator (DCM) 44, 57
 - double-stranded DNA 691–692
 - Drosophila melanogaster* 616
 - dye sensitized solar cells (DSSC) 137, 191
 - dynamical light scattering 179, 184
 - dynamical X-ray diffraction 48
 - dynamic charge transfer 143–145
 - dynamic light scattering (DLS) 94
 - dynamic microtomography
 - CS 364
 - equipment system 363
- e**
- earthworms 614
 - EBSP method 100
 - edge-sharing mode 421
 - effective surface approximation (ESA) 197
 - Eisenia fetida* 614, 615
 - elastic anisotropy 466
 - Elastic Emission Machining (EEM)
 - technology 55
 - electrochemical cycling 64, 83
 - electrochemical method 446
 - electromagnetic power 2
 - electromagnetic radiation 1, 36, 100, 324
 - electromagnetic spectrum 2
 - electron beam emittance 19
 - electron-beam lithography 258
 - electron energy loss spectroscopy (EELS) 275
 - electron microscopy 767
 - electron spectroscopy for chemical analysis (ESCA) 322
 - electron, thermalization of 124
 - electron wave scattering 331
 - elliptical polarization 38
 - energy discrimination 76, 77
 - energy dispersive X-ray diffraction (EDXRD) 461
 - engineered nanomaterials 597, 609
 - ensemble optimization method (EOM) 670
 - environmental scanning electron microscopy (ESEM) 567
 - EPICEA 325, 326, 336
 - equally sloped tomography (EST) 364, 365
 - Error Reductions (ER) 244, 245
 - ethylenediaminetetraacetate (EDTA) 446
 - EUV lithography technology (EUVL) 107
 - Ewald construction 250, 252
 - Ewald sphere 67, 198, 199, 252
 - exit surface wave (ESW) 248
 - Experimental Breeder Reactor-II (EBR-II) 401
 - extended X-ray absorption 394
 - extended X-ray absorption fine structure (EXAFS) 70–73, 396, 398
 - actinide 398–404
 - applications of 404–410
 - methods 454

extended X-ray absorption fine structure (EXAFS) (*contd.*)
 signal 323
 technique 331

f

fast Fourier transform (FFT) 243, 244, 662
 Fast-SAXS-pro program 663–666
 feedback coefficient 245, 246
 $\text{Fe}_3\text{O}_4@/\text{SiO}_2$ core–shell NPs 572
 Fermi level 79
 ferroelectric and magnetic films 65
 filtered back projection (FBP)
 algorithm 98
 -based micro-CT 364, 366
 method 97
 finite element analysis (FEA) 263
 Fit2D program 67
 fixed-exit DCM 50
 flexible-docking simulations 667–668
 fluorapatite 401
 fluorescence energy 127, 128
 fluorescence microscopy 567
 fluorescence X-rays 134
 footprinting 713–716
 forward coherent diffraction imaging (CDI) 246–249
 Fourier transform 4, 79, 82, 83, 183, 242–244, 249, 402, 462
 FoXS approach 662, 664, 665
 Franck–Condon principle 337
 Fraunhofer diffraction 99, 243
 free electron laser 347
 Frenkel defects 403
 Fresnel CDI 247, 248
 Fresnel diffraction 99, 242
 Fresnel theory 54
 Fresnel transmission coefficients 197
 Fresnel zone plate (FZP) 105, 252
 fuel cell 280–284
 functionalized NDs (fNDs) 573, 574, 773
 functional SR angiography (fSRA) 638–640
 fungi 435

g

Gaussian distribution 17
 Gaussian function 89, 326
 $\text{Gd}@/\text{C}_{82}(\text{OH})_{22}$ 604
 gels and colloids 431–432
 Gerchberg–Saxton algorithm 243, 244
 ghost imaging 102
 glancing-incidence RXS 465
 glass-to-melt transformation 405
 goethite 422, 425
 gold nanorods (AuNRs) 608
 gold nanoparticles (AuNPs) 569, 604, 612
 goniometer 62
 graphene oxide 285, 404
 grating interferometer imaging 99
 grazing incidence resonant soft X-ray scattering (GI-RSoXS) 199, 221
 grazing incidence small angle neutron scattering (GISANS) 216
 grazing incidence small angle X-ray scattering (GISAXS) 89, 194–199, 215–223
 patterns 98
 grazing incidence wide angle X-ray scattering (GIWAXS) 94, 194, 199–215
 active layer patterns of 214
 grazing incidence X-ray diffraction (GIXRD) 62, 65, 199, 258
 grazing incidence X-ray scattering (GIXS) 193
 GROMACS 670
 guided-HIO (GHIO) approach 246
 Guinier’s law 92

h

half width at the half maximum (FWHM) 62, 183, 214
 halophilic bacterium 434
 Hanbury, Brown, and Twiss (HBT) experiment 102
 hard X-ray 104, 689
 TXM 758
 hard X-ray diffraction (XRD) 511
 hardened cement paste 402

- heat-sealed polyethylene (PE) bag 395
- Hefei advanced light source (HALS) 27
- helical undulator radiation 6–8
- high energy diffraction 67, 68
- high energy storage ring light 25
- high energy X-ray scattering (HEXS) 394
- high harmonic generation 347
- high-resolution power diffraction 62
- high resolution soft X-ray beamline 324
- high-resolution transmission electron microscopy (TEM) 275
- high resolution X-ray diffraction 258
- high resolution X-ray spectroscopy 324
- highest occupied molecular orbital (HOMO) 192
- Hooke's law 67
- humic acid 427, 471
- Huygens principle 241
- hybrid input–output (HIO) 244, 246
 phase retrieval algorithm 261
- hybrid MBA (HMBA) 22
- hydrogen silsesquioxane (HSQ) 301
- hydrothermal method 441
- hydroxyl radical footprinting 673–675
- i**
- i-motif DNA nanoparticles 712
- immunolectron microscopy 567
- incident angle 66, 197, 198, 261
- inclined geometry 53
- inductively coupled plasma optical emission spectrometry (ICP-OES) 775
- inelastic mean free path (IMFP) 338
- inelastic X-ray scattering (IXS) 394, 462, 466
- inorganic oxide layers 152
- insight on light/matter interaction 342
- in situ* soft XAS 539, 540
- integral equation formalism polarizable continuum model (IEFPCM) 451
- integrative small-angle X-ray scattering (SAXS)-based modeling 673, 675
- Interatomic Coulombic Decay (ICD) 341
- interference effect 40
- interlock system, SR 45–47
- intermediate energy storage rings 27–30
- intermediate-energy transmission X-ray microscopy
 CTF 760
 design 759–760
 DOF 763
 image contrast 760–761
 multimodal imaging 764
 nanoscale spectromicroscopy 764
 radiation dose 761–763
 spatial resolution 764
- intrinsically disordered proteins (IDPs) 672–673
- inverse Fourier transformation 244, 245
- inverse partial fluorescence yield (IPFY) 123, 127–134, 278
- ion-cut process 258
- ionic liquids
 actinide materials in 406–410
 actinides 404–406, 410
- ionization potential 139
- ion solvation effect 537–539
- ion with iminodiacetate (IDA) 415
- iron oxide minerals 421–425
- iterative transformation factor analysis (ITFA) 454
- k**
- kaolinite 427
- Kerr effect 183
- kinetic energy electrons 124
- Kirk–Patrick Baez mirrors 55, 58, 248, 252
- Knudsen cell 145

Kohn-like anomaly 466

Kratky analysis 672

I

laboratory-based diffractometers

61

lamellar structure 92

laminography 608

La₂O₃ NPs 612

laser pyrolysis technique 343

laser speckle contrast imaging (LSCI)

635

lattice cell 19–20

Laue diffraction 62, 68

Laue micro-diffraction 68–69

Laue pattern 48

lensless imaging techniques 242

Le Toullec-type 396

light microscopy 757

light source storage ring

high energy 25

intermediate energy 27–30

longitudinal dynamics 13–14

low energy storage rings 25–27

spectral brightness 17, 19

synchrotron radiation effects

14–17

transverse dynamics 10–13

Li-ion battery 284–288, 539–540

linear combinations of atomic orbitals

(LCAO) 333

line width roughness (LWR) 108

lipid–DNA complexes 725–727

lipopolysaccharide (LPS) 415

liquid crystallines, lattice of

96–97

longitudinal coherence length

240–241

longitudinal dynamics 13–14

Lorentz factor 2

low emittance lattice 19–24

low energy storage rings 25–27

lowest unoccupied molecular orbitals

(LUMOs) 140, 141, 144, 157,

192

Lumbricus terrestris 615

luminescence spectroscopy 430

m

magnetic field 3, 5, 8, 9, 11

magnetic material 82

magnet lattice 10, 25

manganese oxides 427–428

Manning condensation theory 699,

700

manufactured nanoparticles 609

mechanical-linked fixed-exit DCMs 51

Medipix detector 264

metal-catalyzed electroless etching

(MCEE) 296

metallic glasses (MG) 79–82

metal–nucleic acid complexes

695–697

metal-oxide-semiconductor

field-effect-transistors

(MOSFET) 254

1-methyl-4-phenyl-1,2,3,6-

terahydropyridine (MPTP) 579

microbeam radiation therapy (MRT)

648

micro-diffraction 62

micro-EXAFS techniques 434

micro/nano XRD technique 599

microwave sintering 381

microXRF imaging 570

minimal ensemble search (MES) 670,

671

minor actinides 399

mixed-flow reactors 433

mixed oxide (MOX) fuels 398, 399, 444

modified Bronnikov algorithm (MBA)

360

moire pattern 99

molecular dynamics (MD)

method 456–457

simulations 667–670

molecular frame angular distributions

(MFPADs) 323

monochromatic beam 63

monochromatic X-rays 196

monochromator 40

Monte Carlo (MC) simulation 449

Moore's law 254

Multi-Bend Achromat (MBA) 10

multi-channel plate (MCP) 112

- multicomponent envelop-type
 - nanoparticle systems (MENS) 727
- multiple-scattering (MS) calculations 448
- multi-walled carbon nanotubes (MWCNTs) 279
- Mythen1K detector 63, 64
- n**
- nanoaerosolizer 346
- nanoaerosol spectroscopy 323, 343, 344
- nanocatalysis 277
- nanomaterials 77–79
 - aquatic animals 612, 614
 - atmospheric animals 615, 616
 - biological barriers 607
 - characterization of 598–602
 - chemical transformation 609
 - DNA-functionalized 716–725
 - intracellular distribution of 768–770
 - in vitro* and *in vivo* behaviors 602–609
 - metabolic changes 608, 609
 - NOM 610
 - photoreactivity 609
 - plants 611, 612
 - study tools 597
 - terrestrial animals 614, 615
 - three-dimensional (3D) elemental mapping 607, 608
 - toxicological effects 609–616
 - two-dimensional mapping 607
 - two-tier strategy 606
 - whole body distribution 607
- nanometer scale 221
- nanometer–submicron scale 467
- nanoparticles (NPs) 94
- nanopowder 346
- nanoscale aerosol 345
- nanoscale bioimaging
 - animals 775–779
 - coherent imaging techniques 781
 - electron microscopy 767
 - fNDs-DDP 773
 - HeLa cells, biodistribution in 768
 - nanodiamond-ion complexes 770–773
 - nanodiamonds mediated sustained drug release 773–775
 - optical microscopy 767
 - plants 779
 - radioactive analysis 767
 - synchrotron-based techniques, *see* synchrotron-based X-ray microscopy 767
 - nanoscale sSOI structures 263
 - nanoscale three-dimensional (3D) imaging, *see* intermediate-energy transmission X-ray microscopy
 - NanoXRF 571
 - natural organic matter (NOM) 610
 - N-doped CNTs (NCNTs) 279, 280
 - near band gap (NBG) 125
 - near edge X-ray absorption fine structure (NEXAFS) 123, 143, 147, 276, 323
 - signals 147
 - near-infrared (NIR) 301
 - neptunium 415–416, 432–433, 446–447
 - neutron inelastic scattering 179
 - NMR/EXAFS 415
 - noise-free detectors 100
 - non-destructive micro-CT
 - amorphous materials 377–380
 - biomaterials, scaffolds evaluation in 375–377
 - composites, reinforcement distribution of 380–382
 - dynamic evolution research 369
 - hybrid laser welded joints, fatigue crack propagation of 372–375
 - metallic alloy, solidification process of 369–372
 - polymer foam structure 377, 378
 - non-resonant X-ray emission spectroscopy (NXES) 529
 - nuclear chain reaction 399
 - nuclear fission 418
 - nuclear fuels 389, 398–400
 - nuclear wastes
 - disposal 400–402

- nuclear wastes (*contd.*)
 - long-term storage of 420
 - processing 404
- nucleic acid-based nanomaterials
 - DNA, *see* DNA-functionalized nanoparticles
 - RNA, *see* RNA-functionalized nanoparticles
- Nyquist–Shannon sampling theorem 103, 244
- O**
- OLIGOMER program 670
- one-dimensional microstrip silicon detector 64
- operando soft X-ray PIPO microscopy 540–542
- optical band gap 134
- optical microscopy 767
- optical path length difference (OPLD) 241
- optical streak camera (OSC) 133
- optical system, SR 37–39
- organic/electrode interfaces 145–147
 - charge transfer dynamics 148–165
- organic field-effect transistors (OFETs) 137
- organic light-emitting diodes (OLEDs) 137
- organic memory (OMEM) 137
- organic/metal interface 139
- organic molecular beam deposition (OMBD) 145–146
- organic photovoltaic cells (OPVCs) 137
- organic photovoltaics (OPV) 288
- organic/semiconductor interface 139
- organic solar cells 191, 218, 223
 - polymer based 204
 - structure-function relationship for 193
 - systems 197
- organic thin-film transistors (OTFTs) 137
- OSEM-based SAXS–CT 101
- oversampling ratio 244
- overvoltage factor 14
- oxydiacetate (ODA) 415
- oxygen-assisted growth (OAG) 294
- oxygen reduction reaction (ORR) 276, 280
- P**
- pair distribution function (PDF) 62, 68, 462
- partial fluorescence yield (PFY) 278
- particle size distribution (PSD) 88, 367
- peak intensity 62, 63
- permeable reaction barriers 430
- 3,4,9,10-perylenetetracarboxylic-dianhydride (PTCDA) 158
- phase-attenuation duality (PAD)
 - method 361
- phase contrast imaging (PCI) 633
 - hepatic portal vein embolization 645
 - lung cancer detection 644, 645
 - spinal cord microvasculature 643
 - vs.* traditional angiography 644
- phase retrieval algorithm 245
- phase retrieval, CDI 243–246
- [6,6]-phenyl-C61-butyric acid methyl ester (PCBM) 206
 - critical angle of 217
- phonon broadening 328
- phonon dispersion curves 466
- phosphate minerals 430–431
- phosphonate-amino bifunctionalized mesoporous silica (PAMS) 404
- photodiode tube 397
- photoelectric effect 322
- photoelectrochemical (PEC) solar cells 277
- photoelectron spectroscopy 109, 322, 323, 325, 337
 - exchange interaction 340–341
 - Interatomic Coulombic Decay (ICD) 341
 - polarization screening 339
- photoelectron spectrum 329
- photoemission electron microscopy (PEEM) 111–114
- photoexcitation excitation-deexcitation processes 139–142

- photoionization
 coherent multicentre 333–336
 electron diffraction 329–332
 vibrational resolution 332–333
- photoluminescence (PL) 301
- photoluminescence yield (PLY) 294
- photomultiplier (PMT) detector 105
- photon energy 139, 141, 144, 147
- photon-in–photon-out (PIPO)
 spectroscopy 530–532
- picometer sensitivity 249
- planar undulator radiation 5–6
- platinum nanoparticle (PtNP) 277
- plutonium 391, 398, 416–417, 439,
 444–446
- point detector 64
- Poisson–Boltzmann (PB) approximation
 699
- polarization screening 339
- poly(3-hexylthiophene) (P3HT) 194,
 207, 209, 288
 film 204, 206, 208
- polyacrylic acid 471
- polyelectrolyte membrane (PEM)
 electrochemical cells 523, 525
- polymer solar cell acceptor (PSCA)
 289
- polytetrafluoroethylene 396
- potential energy curve (PEC) 337
- powder diffraction (PD) 62–64
- preoperative portal vein embolization
 (PVE) 645
- pristine nanomaterials 601
- propagation-based imaging 99
- prostate specific antigen (PSA) 94
- Protein Data Bank 687
- Ptychographical Iterative Engine (PIE)
 algorithm 249
- ptychography 249
 BCDI 258
- pyrochlore 401
- pyrolytic boron nitride (PBN) 396
- q**
- quadrupole-bend achromat (QBA) 10
- quadrupole magnets 10, 13, 19, 20
- quantitative analysis 103–104
- quantitative in-line phase-contrast
 micro-CT
 DCM 362, 363
 dynamic microtomography
 363–364
 phase retrieval 358–363
- quantum dots (QDs) 301–303, 608,
 613
- quantum effects 14
- quantum mechanical (QM) method
 449–456
- quantum mechanics/molecular
 mechanics (QM/MM) 456
- quantum size effect, Si NCs 301
- quartz crystal microbalance (QCM)
 146
- quasi-monochromatic 37
- r**
- radiation damage effects 403
- radiation damage theory 403
- radiation damping effect 57
- radiation dose 761, 763
- radiation power spectrum 3
- radiation protection standards 393
- radiation safety, SR 45–47
- radioactive analysis 767
- radioactive materials 390
- radioactive wastes 400
 microorganisms in 443
- radionuclides
 adsorption and/or incorporation
 429
 double confinement against 397
 formation and transformation of
 395
 leaching rate of 400
 mechanisms of 420
 mobility by direct enzymatic 434
 mobility of 443
 oxidation state of 442
 physical properties of 444
 risk of 398
 sorption of 442
 transport behavior of 427
 transportation of 420
- radius of gyration 672

- Raman spectroscopy 257, 258, 275, 430, 567, 568
- rare earth elements 400
- Rayleigh wave solution 262
- reactive flux method 441
- reactive ion etching (RIE) 259
patterning 261
- reciprocal space mapping 62
- red fluorescent CdSe/ZnS nanoparticles 616
- reduced graphene oxide (rGO) 107, 283
- reference orbit 10
- refractive index 55, 197, 198
- refractive lens 248
- resonant Auger electron spectroscopy (RAES) 142
- resonant inelastic soft X-ray scattering (RIXS) 114–116, 465, 513, 514, 527–530, 532–535, 537, 538
- resonant photoemission (RPE) 337
- resonant photoemission spectroscopy (RPES) 143, 156, 158
approach 147
- resonant technique 465
- resonant X-ray magnetic scattering (RXMS) 465
- resonant X-ray scattering (RXS) 394
- respiratory tract lining fluids (RTLF) 601
- reverse Monte Carlo (RMC) method 448
- rigid-body docking methods 667
- RNA-functionalized nanoparticles 689
metal-binding sites 696
multivalent ions 703
noncanonical structures 711–713
probing intermediates in RNA folding 706–711
ribozyme folding process 706, 711
synchrotron footprinting 714, 716
- rotational broadening 327
- RotPPR scheme 669
- routine analysis method 466
- Rydberg electron 341
- S**
- scanning electron microscopy (SEM) 193, 599
- scanning transmission electron microscopy (STEM) 280
- scanning transmission X-ray microscopy (STXM) 105–107, 276, 279, 283, 394, 471–472, 564, 768
- scanning tunneling microscopy (STM) 275
- scattering intensity 86, 87, 92, 197, 222
- scattering spectroscopy 391
- Scherrer equation 201
- Schultz size distribution 215, 216
- sea urchins 613
- second order Legendre polynomial 331
- second-order Møller–Plesset perturbation theory 449
- selective chemical etching 256
- self-absorption effect 77
- self-assembled monolayers (SAMs) 146, 147, 152
- self-assembled monolayers (SAMs)–electrode interface 139
- self-assembled pyramids 94
- serial block face scanning electron microscopy (SBFSEM) 382
- sextupole magnets 9, 13, 19, 20
- shake-up and shake-off 329
- short channel effects (SCE) 254
- Si drift detectors 123
- Si nanowires (SiNWs) 275–277
bottom-up VLS 294–296
metal nanoparticles modified 298–301
quantum dots 301–303
top-down, electroless and chemically 296–297
- signal-to-noise level 76
- signal-to-noise ratio 244
- silicon drift detector (SDD) 129
- silicon nanocrystal (Si-NC) 301
- silicon-on-insulator (SOI) structures 254–256
- silver nanomaterials 613

- silver nanoparticles (Ag NPs) 605, 606, 610
- single-crystal X-ray diffraction 62
- single-shot SXRL 186
- single-walled carbon nanotubes (SWCNTs) 278
- small-angle X-ray scattering (SAXS) 84, 100, 194, 394, 706
 - application of 92–97
 - atomic-level representation 662
 - coarse-grained molecular representation 662
 - computing methods 657
 - DNA nanostructures 717
 - experimental setup 89–92
 - film morphology and microstructure 94
 - hydration contribution modeling 664, 665
 - hydroxyl radical footprinting 673–675
 - integrative modeling 673, 675
 - intrinsically disorder proteins, structural characterization of 672, 673
 - intensity 91
 - lamellar structure 92
 - liquid crystallines, lattice of 96–97
 - nucleic acids
 - conformations 706
 - electrostatic interactions 697–706
 - residue/nucleotide-simplified representation 662–663
 - self-assembled pyramids 94
 - space-filling bead modeling 666
 - structural conformation generation
 - ensemble-based analysis 670–672
 - exhaustive conformational search 668–669
 - flexible-docking simulations 667–668
 - MD simulations 667–670
 - protein–protein complexes 666
 - rigid-body docking methods 667, 669–670
 - theory 84–89
 - three-dimensional periodic framework 93
 - X-ray scattering of electrons 84–85
- small-angle x-ray scattering-computed tomography (SAXS-CT) 100–102, 367
- small-core effective core potentials (SC-ECPs) 449
- Snell's law 54
- soft X-ray 104
- soft X-ray beam 187
- soft X-ray instrumentation 324–325
- soft X-ray interference lithography (XIL) 107–108
- soft X-ray methodology 104–116
- soft X-ray microscopy 758
- soft X-ray photoelectron spectroscopy 331
- soft X-ray speckle
 - from polarization clusters 181–183
 - from surface a/c domains 180–181
- soft X-ray spectroscopy (SXS) 323, 344, 511, 689
 - atmospheric sciences 343–345
 - concrete applications 342–343
 - heterogeneous catalysis 345–346
 - insight on light/matter interaction 342
- soft X-ray techniques 128, 134
- solar cell 288–289
- solid oxide electrochemical cells (SOCs) 520, 523
- solid-state reaction technique 402
- Soller slits 77
- space-filling bead modeling 666
- speed of light 36
- spinning capillary mode 63
- SPring-8 39–41, 45, 56–58
- SPring-8-II 56, 57
- SR micro-computed tomography (SR μ CT) 643
- SR micro-XRD (SR- μ -XRD) method 459
- SR micro-XRF (SR- μ -XRF) 467–470
 - mapping 469
 - technique 469, 470
- SR powder XRD (SR-PXRD) 458–459

- SR single crystal XRD (SR-SCXRD)
 - 458
- standard distribution deviations 17
- storage ring
 - beam dynamics 9–19
 - lattice of 20–24
- strain distribution
 - in SOI structures 254–256
 - in sSOI 257–265
- strained silicon-on-insulator (sSOI)
 - 239, 255
 - nanostructures 264–265
 - strain distribution in 257–258
 - strain relaxation in 258–264
- strain engineering 255
- strong accepting–strong accepting (SA-SA) 213
- sulforhodamine B 712
- sulfur-doped graphene 286
- surface core-level shift (SCLS)
 - 328–329
- surface diffraction 64–67
- surface-enhanced Raman scattering (SERS) 94
- surface EXAFS (SEXAFS) 70
- Swiss Light Source (SLS) 102, 115
- Syassen–Holzapfel-type 396
- synchronous orbit 11
- synchrotron-based X-ray angiography
 - 578
- synchrotron-based X-ray microscopy
 - Alzheimer’s disease, quantitative images of 578
 - mouse microvascular imaging 576, 578
- nanomaterials, cell effects of
 - AgNPs 576, 577
 - AuNPs 576
 - carbon nanotubes (CNTs) 573
 - functionalized NDs (fNDs) 573, 574
 - nanodiamonds (NDs) 574, 575
 - nuclear techniques 572
 - transmission electron microscopy (TEM) 572
- nanomaterials, *in vivo* bioeffects of
 - animals 581–583
 - model organisms 579–581
 - plants 583–585
- nanoscale bioimaging
 - animals 775–779
 - coherent imaging techniques 781
 - fNDs-DDP 773
 - HeLa cells, biodistribution in 768
 - nanodiamond-ion complexes 770–773
 - nanodiamonds mediated sustained drug release 773–775
 - plants 779
- synchrotron beam 65
- synchrotron footprinting 713–716
- synchrotron light sources
 - low emittance lattice 19–24
 - storage ring and beam dynamics 9–19
 - storage ring light sources, status of 24–30
 - synchrotron radiation generation
 - 1–9
 - third generation 123
- synchrotron pulse 125
- synchrotron radiation, *see also* electromagnetic radiation
 - actinide research 390
 - crystal monochromators 47–54
 - effects 14–17
 - generation 1–9
 - high flux and high-energy beams 390
 - optical system 37–39
 - photoelectron spectroscopy 323
 - radiation properties 36–37
 - radiation safety and interlock system 45–47
 - storage ring and beam dynamics 9–19
 - techniques 390, 391, 393, 394, 466, 468, 470, 472
 - X-ray beamlines 39–45, 56–59
 - X-ray lenses 55–56
 - X-ray mirrors 54–55
 - X-ray optics 47–56
 - X-ray scattering 93

- synchrotron radiation based
 - micro-tomography (SR- μ CT) 103, 104
 - synchrotron radiation circular
 - dichroism (SRCD) 692–694
 - synchrotron radiation micro X-ray
 - diffraction (SR- μ -XRD) 394
 - synchrotron radiation micro X-ray
 - fluorescence (SR- μ -XRF) 394
 - synchrotron radiation powder X-ray
 - diffraction (SR-PXRD) 394
 - synchrotron radiation single crystal
 - X-ray diffraction (SR-SCXRD) 394
 - synchrotron radiation XPS (SR-XPS)
 - technique 599
 - synchrotron radiation X-ray
 - fluorescence (SR-XRF) 466–471
 - synchrotron radiation (SR) X-ray
 - imaging
 - ACI, *see* absorb-contrast imaging (ACI)
 - advantages 634–635
 - development of 645–648
 - magnetite nanocluster probe 646
 - microbubbles 647–648
 - MRT 648
 - PCI, *see* phase contrast imaging (PCI)
 - principle 633–634
 - properties 634
 - safety 648
 - tumor angiogenesis 646–647
 - synchrotron techniques 277, 280, 689–697
 - synchrotron X-ray source 64
- t**
- Talbot interferometer 99
 - target transformation factor analysis (TFA) 449
 - temporal intensity correlation 183–189
 - Tetrahymena thermophila* ribozyme 714, 716
 - theory of electromagnetism 687
 - 3D image reconstruction, CDI 247
 - theoretical minimum emittance (TME) 20
 - lattice cells 21
 - thermal annealing 215
 - thermal conductivity 258
 - Thomson scattering formula 85
 - thorium 391, 405–406, 417–418, 463
 - three-dimensional X-ray diffraction (3DXRD) 99–100, 364–367
 - time-resolved synchrotron X-ray
 - footprinting 713–716
 - time-resolved XEOL (TRXEOL) 133–134
 - TiO₂ nanocomposite (nano TiO₂) 615
 - TiO₂ nanoparticles 569, 600, 607, 609
 - titanium dioxide 345
 - titanium dioxide nanoparticles (nano-TiO₂) 611
 - total electron yield (TEY) 124, 128, 278
 - total fluorescence yield (TFY) 278
 - total pair distribution function 79, 81
 - total reflection synchrotron X-ray
 - fluorescence 470–471
 - transmission electron microscopy (TEM) 257, 402, 599
 - transmission geometry 194
 - transmission X-ray microscopy (TXM) 603
 - transuranium extraction (TRUEX) 455
 - transverse coherence length 240
 - transverse dynamics 10–13
 - triple-bend achromat (TBA) 10
 - two-dimensional (2D) GISAXS intensity
 - distribution 197
 - patterns 95
 - two-dimensional GIXRD 65
 - 2D XANES-XEOL 131–134
- u**
- ultra-fast dissociation (UFD) 322, 336
 - ultra-high-vacuum (UHV) 40, 110, 145
 - ultra-large scale integration (ULSI) 254
 - ultra-pure SAM 147

- ultra-small angle X-ray scattering (USAXS) 88
 - ultra-violet–visible absorption 454
 - undulator radiation 5, 37, 54
 - undulator spectrum 56
 - uranium 398, 404–405, 410–415, 421–432, 434–443
 - anodic dissolution of 405
 - cations 441
 - chemical valences of 441
 - sequestration of 423
 - soft X-ray XANES data 441
 - solutions 462, 463
 - uranium nanocrystalline phase 402
 - uranium nitride 399, 461
 - uranium oxidation state 396
 - uranium–plutonium mixed fuel 459
 - uranyl aluminate (URAL) 402
 - uranyl ions 415
- V**
- valence band 139, 140, 256
 - vector algorithm 85
 - vibrational broadening 327
- W**
- weak accepting–strong accepting (WA-SA) 213
 - wet coherent X-ray diffraction microscopy 565
 - wide angle X-ray scattering (WAXS) 88, 199
 - wiggler radiation 8–9, 36, 37
 - Wigner-crystal based formulation 701
- X**
- X-ray absorption coefficient 69, 123
 - X-ray absorption edge 69
 - X-ray absorption fine structure (XAFS) 69, 70, 275, 390
 - actinide 398, 439
 - cathode material 82–83
 - experiments 73–77
 - magnetic material 82
 - metallic glasses (MG) 79–82
 - nanomaterials 77–79
 - simulations 448–449
 - spectroscopy 430, 457
 - theory 70–73
 - X-ray absorption near edge structure (XANES) 70, 82, 123, 128, 130, 131, 276, 279, 282, 394, 399, 691
 - IPFY 123
 - X-ray absorption spectroscopy (XAS) 70, 123, 143, 276, 391, 434, 690–692
 - X-ray-based fluorescence spectroscopy (XRF) 578, 579
 - X-ray beamlines 39–45, 56–59
 - X-ray computed tomography (X-ray CT) 97–99
 - X-ray correlated imaging 102–103
 - X-ray crystallography 457, 603
 - X-ray diffraction (XRD) 61–69, 391, 398, 402, 403
 - in actinide material 457, 461
 - patterns 64
 - techniques 257
 - X-ray diffractive imaging 38
 - X-ray emission spectroscopy (XES) 276, 528–530, 532, 535, 690–692
 - X-ray excited optical luminescence (XEOL) 123, 125, 128, 294
 - X-ray fluorescence (XRF) 125, 466
 - computed tomography 357
 - spectrum 128, 130
 - X-ray fluorescence yield (FLY) 124, 128
 - X-ray free electron laser (XFEL) 138
 - X-ray intensity 67, 74
 - X-ray irradiation 277
 - X-ray lenses 55–56
 - X-ray magnetic circular dichroism (XMCD) 112, 600
 - X-ray microscopic techniques 469
 - X-ray mirrors 54–55
 - X-ray optics 47–56
 - X-ray photoelectron spectroscopy (XPS) 275
 - multiscale experimental tool 322–323
 - X-ray reflectivity 62
 - X-ray scattering (XRS) 462, 466

- of continuous-distribution electrons
 - 85–86
 - of electrons 84–85
 - of multiple particles 88–89
 - of single particle 86–88
 - techniques 462
 - X-ray spectroscopy techniques 66
 - X-ray standing-wave (XSW) 62, 66–67
 - method 66
 - X-ray technique 62
 - X-ray wavelength 66
 - XPCS 185
- Y**
- Yoneda peak 196, 198, 219
 - Young's double slit 240
 - Young's double slit experiment (YDSE)
 - 334, 335
- Z**
- Zernike phase contrast technique 758,
 - 760–762, 764
 - zirconolite 401
 - ZnO nanoparticles 604, 611, 613

