

Index

a

activation energy 1, 17–20, 33, 25–29, 33–37, 103, 211
 adsorption 2, 69
 alkali promoter 70, 71, 264–271
 alloy, surface segregation 208, 302
 ammonia synthesis 2, 19, 97, 98, 104, 117, 121, 264
 ammoxidation 2, 87, 88, 98, 117
 angle-dependent XPS 59–62
 annular dark field 186–189
 anomalous scattering 154
 area, specific 2, 3
 Arrhenius equation 17, 25, 33, 35
 atom probe microscopy 197
 atomic force microscopy 180, 197–208, 233, 285, 290, 291
 attenuated total reflection 224, 225, 233, 234
 attenuation length, electron 45
 Auger decay 41, 42, 74–78, 90, 113, 190
 Auger electron spectroscopy 40–42, 74–81, 184, 252, 260, 280
 automotive exhaust catalysis 1, 36, 37, 98, 102, 117, 252, 264

b

back donation 234, 316
 backscattered electron 181, 184
 backscattering (in AES) 78
 backscattering amplitude (EXAFS) 162–164
 band structure 305
 bimetallics 26
 body-centered cubic 298
 bonding in metals 306
 Bragg diffraction 184
 Bragg's law 148–151
 Bravais lattice, surface 300

Bremsstrahlung 148, 190, 192
 Bremsstrahlung isochromat spectroscopy 67
 bridging the gap strategy 8
 broken-bond model 301, 302
 Brunauer–Emmett–Teller equation 2

c

catalysis, heterogeneous 1, 297
 catalytic cycle 2
 cathodoluminescence 182
 charge-potential model 48, 49
 charging 52, 53, 80, 95, 184, 185, 252
 chemical potential 309
 chemical promoter 4, 265
 chemical shift 46
 chemisorption 3, 311–319
 CO hydrogenation 2, 22, 23, 100, 141–143
 CO oxidation 2, 31, 35, 36, 213, 214
 cohesive energy 301, 306
 compensation effect 29, 30
 contracting sphere model 16
 coordination number 163, 164, 168, 169, 189, 258, 259, 280, 298
 core hole 42, 48, 52, 69, 74–77
 corrugated surface 299
 Coulomb interaction 109, 112, 199
 Coulomb potential 112
 cross section 44, 45, 133, 239
 crystallography, surface 297–301
 cyclotron 110

d

Debye model 123, 124, 303
 Debye temperature 124, 137, 159, 303, 304
 degree of freedom 220
 density functional theory 313, 319
 density of states 49, 50, 66–68, 207, 265, 306–311

- depth profiling 80, 81
- desorption 23–35
- diffraction 147–159
- diffuse reflection infrared Fourier transform spectroscopy 224, 225, 230–233
- dipole coupling 224, 227, 228
- dipole moment 265–268
- dipole scattering 243, 244
- dispersion 3, 54–59, 167–170, 255
- dissociative adsorption 2, 101–103, 316–319
- Doppler effect 126
- dual anode source 42

- e**
- Einstein model 303
- electric quadrupole splitting 129–131, 134
- electromagnetic spectrum 6, 7
- electron affinity 92, 311–319
- electron energy loss spectroscopy 217, 224, 227, 243–247, 268–271
- electron microprobe analysis 190–193
- electron microscopy 179–211
- electron spectroscopy for chemical analysis 39
- electronegativity 47
- electronic structure, of surface 305–311
- electrostatic potential 266–269
- elementary reaction 103, 104
- ellipsometry 213, 214
- ellipsometry microscopy for surface imaging 212–214
- emission, kinetic and potential 90, 95
- energy dispersive X-ray analysis 190, 193
- ensemble effect 227–229
- environmental scanning electron microscopy 185
- ethylbenzene dehydrogenation 213
- ethylene epoxidation 62, 98
- extended X-ray absorption fine structure 147, 148, 159–175, 232, 254, 257–264, 274, 280–284, 291

- f**
- face-centered cubic 298
- fast atom bombardment 90
- Fermi level 49, 50, 66–70, 173, 195, 207, 265, 269, 307–319
- Fermi's Golden Rule 67
- field emission 194
- field emission microscopy 180, 193–197
- field ion microscopy 180, 193–197
- field ionization 195
- final state effect 48, 51, 63, 67, 69, 164

- Fischer–Tropsch synthesis 2, 15, 19, 117, 121, 135–137, 174, 175, 180, 264
- fluorescence 239
- Fourier Transform 162–168
- Fourier Transform infra red 226
- Fowler Nordheim equation 194
- free electron gas 306, 309, 317
- frontier orbital concept 315
- fundamental vibrations 221

- g**
- group frequency 222

- h**
- harmonic oscillator 218–220
- heat of adsorption 25
- heat of vaporization 27
- Heisenberg's uncertainty relation 52
- heterogeneous catalysis 1, 297
- hexagonally closed packed 298
- high resolution electron energy loss spectroscopy *see* EELS
- high-angle annular dark field 186–189
- highest occupied molecular orbital 307, 309
- hydrodenitrogenation 272
- hydrodesulfurization 21, 22, 99, 117, 121, 208–210, 229, 230, 272–284
- hyperfine interactions 122, 126–136

- i**
- image potential 194
- impact scattering 243, 244
- impregnation 3
- in situ 4, 9, 121, 135, 139–142, 152, 153, 171–175, 190, 211, 224, 225, 235–239, 277
- inelastic mean free path *see* mean free path
- inelastic neutron scattering 217
- Infrared emission spectroscopy 224, 225, 235
- infrared imaging 214
- infrared radiation 218
- Infrared reflection absorption spectroscopy 226
- infrared regions 222
- infrared spectroscopy 217–220, 224–235, 239, 261, 262, 279, 289
- initial state effect 48, 51, 63, 67
- inverse photoemission 270
- ion scattering 106–110
- ion scattering spectroscopy 85, 106–117
- ionization potential 92–94, 195, 265, 307–319
- ionization probability (in AES) 77, 88, 92

- isoelectric point 241, 254
 isomer shift 128–131, 134, 277
 isotopes in infrared spectroscopy 220, 221, 227
 isotopes in mass spectrometry 36, 37
 I–V plots 158
- j**
 jellium model 265, 266, 309, 311–313
- k**
 Kelvin probe 309
 kinematic factor 106–110, 114
 kinetic parameters 103
 Kubelka-Munk function 225
- l**
 Langevin equation 139
 lateral interactions 26, 28
 lattice vibrations 123, 124, 164, 218, 302–304
 Lennard-Jones potential 199
 Lindemann criterion 304
 line width 51, 52
 local work function 71–74, 268, 310, 311
 low energy electron diffraction 147, 155–159, 212, 245–247, 302, 304
 low energy ion scattering 85, 112–117
 low-index surface 298, 299
- m**
 Madelung sum 49
 magnetic hyperfine splitting 131, 134
 magnetization 137
 Mars-van Krevelen mechanism 98
 mass spectrometer 12, 24, 87
 mass transfer limitation 35
 matrix effect 87, 95, 101, 105
 mean free path 6, 40, 41, 44–46, 50, 59, 60, 63, 67, 78, 79, 155, 163, 304, 309
 mean squared displacement 302–304
 metal support interaction 259–261
 metal surfaces, theory of 297–310
 metallic bond 306–311
 metal-support interaction 4
 metastable atom excitation spectroscopy 73, 74
 metastable ion excitation spectroscopy 73, 74
 metathesis 95
 methanol synthesis 79, 80, 98, 142, 171
 microscopy 179–211
 model catalysts 8, 252
 model support 252
 model systems 292
 molecular orbital theory 305, 311–319
 momentum, total 43
 monochromator, infrared 226
 monochromator, X-rays 52, 53
 Morse potential 219, 220
 Mössbauer effect 122–125
 Mössbauer parameters 127, 128, 134
 Mössbauer spectroscopy 121–145, 277–281, 302
 multiplett splitting 50, 51
- n**
 neutralization 90, 93, 106, 112–115
 NEXAFS *see* X-ray absorption near edge spectroscopy
 nuclear reaction in RBS 110
 nucleation and growth 16, 20
- o**
 orbital momentum 43
 oscillating reaction 197, 211–214
 overtone 219, 220
 oxidation of CO 2
- p**
 particle size 151, 152, 169, 170, 187–189, 192, 193
 partition function 32, 33
 phase shift 162–166
 Phillips catalyst 185, 186, 284–291
 phonon 123, 243, 303, 304
 photoelectric effect 39–41
 photoelectron 39–41, 159–161, 191
 photoelectron diffraction 62
 photoelectron emission microscopy 180, 212
 photoemission 39, 42, 48, 49, 267, 268, 307–309
 photoemission of adsorbed xenon 71–74, 266, 311
 photon sources 7
 physisorption 2, 71
 plasmon 50, 75, 164
 poison 4, 97, 98
 polarizability 239
 polyethylene 284–291
 polymerization catalysis 185, 186, 205, 284–291
 pore volume 3
 preexponential factor 25, 27, 33–36, 211
 probing depth 44
 promoter 4, 70, 97, 98, 234, 264–271
 pulsed field desorption mass spectrometry 197

q

quadrupole moment 129
 quadrupole splitting *see* electric quadrupole splitting
 quantum numbers of electrons 43, 223
 Quick EXAFS 170–172, 274–276

r

Raman scattering 224
 Raman spectroscopy 217, 218, 220, 235–243
 rate of desorption 25
 rate of reaction 35
 rate-determining step 2
 Rayleigh scattering 238, 239
 reciprocal lattice 156, 157
 recoil free fraction 122–124, 132–134, 144
 reduced mass 219
 reduction 3, 13–21, 171, 172, 255–257
 reference compounds 292
 reflection absorption infrared spectroscopy 224–227, 234, 235, 244–247, 271
 reflection anisotropy microscopy 214
 reionization 112, 114
 relaxation 48, 76, 164
 resonance neutralization 113
 rotational energy 218, 222, 234
 Rutherford backscattering spectroscopy 85, 108–111, 273, 274, 286–289

s

scanning Auger microscopy 80, 278–280
 scanning electron microscopy 182, 184–186
 scanning force microscopy 180, 197–208, 290, 291
 scanning probe microscopy 197–211
 scanning transmission electron microscopy 80, 182, 186–189
 scanning tunneling microscopy 180, 197, 198, 205–211, 282, 311
 scanning tunneling spectroscopy 208
 scattering cross section 108–110, 113
 Scherrer equation 151
 second order Doppler shift 127–129
 secondary electrons 66, 75, 184
 secondary ion mass spectrometry 85–105, 252, 257, 260, 273, 285–287
 secondary neutral mass spectrometry 86, 105, 106
 selection rule 217, 220, 226, 239, 244
 selective chemisorption 59, 167–170
 selective oxidation 2, 87, 88, 98, 117, 143

shake up, shake off 50, 51, 164
 shrinking core model 16
 single crystal 8
 sintering 4, 302
 small angle X-ray scattering 154
 solid state reaction 152, 153
 spectroscopic notation 43
 spin-orbit splitting 43, 44
 sputter yield 88–90, 93, 105
 sputtering 86–90, 93, 105, 155, 117
 static disorder 164
 static secondary ion mass spectrometry 94, 101–104
 sticking coefficient 65
 Stokes band 238, 239
 strong metal support interaction 252, 260, 261
 structural promoter 4, 265
 subsurface species 62
 sulfidation 21–23, 110, 111, 241, 272–276, 283
 sum frequency generation 224, 235–238
 superparamagnetism 137, 139, 142
 support 2, 3
 supported catalyst 3, 4
 surface core-level shift 308, 309
 surface free energy 46, 166, 301, 302, 306
 surface sensitivity 6, 41, 50, 54, 59, 79, 86, 112, 117
 synchrotron 7, 40, 63, 64, 67, 148, 153, 154, 160, 171, 172

t

take-off angle 59–62
 temperature programmed desorption 23–35, 29–31, 102, 270, 271
 temperature programmed oxidation 11, 12, 18
 temperature programmed reaction spectroscopy 22, 23, 35
 temperature programmed reduction 11–13, 16–18, 254
 temperature programmed secondary ion mass spectrometry 102
 temperature programmed sulfidation 21, 22, 272–276
 temperature programmed techniques 11–38
 thermal conductivity detector 12
 thermal desorption spectroscopy 23
 thermodynamics, of reduction 13, 14
 threeway catalyst *see* automotive exhaust catalysis

trajectory, ion 112, 113, 115
 transition state theory 26, 29, 31, 32, 34
 transmission electron microscopy 180,
 182–186, 260, 261
 transmission infrared spectroscopy
 227–230

u

ultra violet photoelectron spectroscopy 40,
 41, 65–74, 266, 269–271, 309, 311
 unit cell 300
 UV Raman spectroscopy 239, 240
 UV source 65

v

vacuum level 50, 71, 72, 307–319
 vacuum, ultrahigh 8
 valence band 49, 50, 66, 67, 113, 194
 van de Graaf accelerator 110
 van der Waals forces 200
 vibrational energy 218
 vibrational spectroscopy 217–247
 vibrations, types of 221
 vicinal surface 299

w

wave number 161
 white line 173, 174
 Wood's notation 156, 158, 246, 300
 work function 41, 48, 50, 66–71, 76, 93,
 113, 194–197, 205, 206, 265–268, 307–319

x

X-ray absorption near edge spectroscopy
 147, 159–161, 172–175, 232, 254, 291
 X-ray absorption spectroscopy 147, 148, 159
 X-ray diffraction 147–154, 171, 172, 276
 X-ray emission 190–193
 X-ray fluorescence 52, 75, 77, 148, 190, 191
 X-ray notation 43
 X-ray photoelectron spectroscopy 39–65, 45,
 51, 52, 54–58, 63–65, 148, 247, 252–257,
 273, 274, 283, 284, 285–287, 289, 309
 X-ray source 41, 51

z

ZAF correction 192
 Zeeman effect 131
 Ziegler-Natta catalyst 284, 285