

Index

a

- accelerated degradation test (ADT)
 - 165
- ALD 212
 - anode 198–199, 216
 - cathode 216
 - cycle 5, 16, 212
 - doped ZnO 74–77
 - electron-selective contacts 87–89
 - FTIR 15
 - growth characteristics 5–8
 - in situ* techniques 16
 - In₂O₃ 78–79
 - Li-Al-O (LiAlO₂) 190
 - Li-Al-Si-O 191
 - Li-La-O 189
 - Li₂CO₃ 189
 - Li₃N 192
 - Li₃PO₄ 192
 - Li_xSi_yO_z 191
 - LiCoO₂ 195
 - LiF 194
 - LiFePO₄ 197
 - LiNbO₃ 192
 - linearity 5–8
 - LiPON 193
 - LiTaO₃ 192
 - lithiation 196
 - LLT 189–190
 - metal chalcogenides 111–115
 - MnO_x/Li₂Mn₂O₄/LiMn₂O₄ 196
 - nanoporous materials 29–34
 - OES 15–16
 - passivating contacts 47
 - plasma-enhanced ALD (PE-ALD)
 - 8–11
 - Pt deposits 215–216
 - QCM 12–13
 - QMS 13–14
 - reactor 12
 - saturation and ALD window 5–8
 - SE 14–15
 - Si heterojunction solar cells 46–47
 - Si homojunction solar cells 44–46
 - sulphides 198
 - supercycles 75
 - TiO₂ films 124
 - transition metal oxides
 - electrocatalysts 174
 - tunneling oxides 86
 - V₂O₅ 194
- ALD metal chalcogenides
 - bismuth sulfide (Bi₂S₃) 114
 - cadmium sulfide (CdS) 113
 - CIS 112
 - Cu₂S 112–113
 - CZTS 112
 - indium sulfide (In₂S₃) 114
 - PbS 113
 - Sb₂S₃ 113
 - SnS 113
- ALD process
 - conformality of 16–21
 - modellings 21–24
 - nanoporous materials 29–34
 - plasma-enhanced ALD 24–29
- ALD-Pt cells 157
- Al₂O₃ films 56, 57

- aluminium back-surface field (Al-BSF) 44
- anodic aluminum oxide (AAO) 17, 135, 165
- anti-reflection coating (ARC) 44
- antireflective coatings 102
- artificial photosynthesis (APS) 225
- aspect ratio (AR) 4, 17, 22
- atmospheric pressure (AP) 59
- atmospheric pressure chemical vapor deposition (APCVD) 238
- atomic-layer/molecular-layer deposition (ALD/MLD) 263
- Auger recombination 48, 82

- b**
- band bending 52
- band gap 69, 126, 229, 239
- bismuth sulfide (Bi_2S_3) 114
- blocking layer 126
- Boltzmann constant 22, 48
- Boron-doping 77
- Bragg mirrors 68
- Brillouin zone 102, 103
- Burstein–Moss (BM) shift 71, 72, 74

- c**
- cadmium sulfide (CdS) 113
- carbon black (CC) 162
- carbon monoxide (CO) 162
- carbon nanotube (CNT) 136, 154
- carbon spheres (CS) 164
- carrier density 48, 69–73
- carrier mobility 69, 71, 77, 260
- catalytic probes 26
- C–C bonds 216
- chalcogenide materials 111
- charge carriers 48
- charge extraction length (L_{CE}) 105
- chemical passivation 50
- chemical spray pyrolysis (CSP) 212
- chemical vapor deposition (CVD) 4, 59, 104, 108, 212
- chronoamperometric tests 162
- chronoamperometry (CA) 161
- CIS 112
- colloidal quantum dot solar cell (CQDSC) 120, 133
- conduction band (CB) 227
- conformality 3–34, 66, 115, 137
- constant-voltage durability test 158
- core-shell structures 238
- corona oxide characterization of semiconductors (COCOS) 56
- Coulombic scattering 69
- crystalline silicon (Si) solar cells 43
- Cu_2S 112
- cyclic voltammetry 125
- cyclopentadienyl indium (InCp) 135
- CZTS 112

- d**
- dechlorosilylation reactions 266
- density functional theory (DFT) methods 268
- dielectric constant 30, 88
- dimethyl cadmium (DMCd) 134
- direct ethanol fuel cells (DEFCs) 159
- direct formic acid fuel cells (DFAFCs) 159
- direct liquid-fed fuel cells (DLFCs) 159
- direct methanol fuel cells (DMFC) 209
- doping 51
- Drude absorption 72
- dual thermocouples 26
- dye-sensitized solar cells (DSSCs) 113, 119, 244
- dye/MOx structure 130

- e**
- electrocatalytic tests 169, 171
- electrochemical performance
 - hydrogen evolution reaction (HER) 167
 - hydrogen oxidation reaction (HOR) 157–159
 - methanol/ethanol/formic acid oxidation reaction (MOR/EOR/FOR) 159–164
 - oxygen reduction reaction (ORR) 164–167
- electrochemical vapor deposition (EVD) 212

- electrochemically active surface area (ECSA) 163
- electron probe microanalysis (EPMA) 17
- Eley–Rideal mechanism 10
- ellipsometric measurement 14
- ellipsometric porosimetry (EP) 31
- energy-enhanced ALD 55
- epitaxy 109
- expanding thermal plasma (ETP) 73
- extremely thin absorbers (ETAs) 107, 230, 233
- f**
- Faradaic efficiency 246
- Fermi–Dirac statistics 49, 53
- Fermi level E_F 71
- ferroelectric material 192
- field-effect passivation 51, 54
- field-emission scanning electron microscopy (FE-SEM) 271
- fluorine-doped tin oxide (FTO) 234
- Fourier transform infrared spectroscopy (FTIR) 15, 268
- free carrier absorption (FCA) 72
- free carrier reflection (FCR) 72
- Fresnel equations 14
- Fresnel's reflection laws 101
- FTIR, *see* Fourier transform infrared spectroscopy (FTIR)
- g**
- gadolinia-doped ceria (GDC) 214
- gas conductance equations 22
- generic coating technique 5
- Gordon model 23
- graphene nanosheets (GNS) 160
- graphene oxide (GO) 164
- grazing incidence small angle x-ray scattering (GISAXS) 16, 31
- growth per cycle (GPC) 5, 12, 67
- growth per super cycle (GPSC) 76
- h**
- HAADF-STEM image 173
- heat capacity (C) 261
- Hf(NMeEt)₄ 64
- highly-doped region (HDR) 51
- high temperature fuel cells (HTFC) 209
- high-volume manufacturing (HVM) 43, 58
- hole transporter material (HTM) 120
- HOMO 184
- hybrid cell design 47
- hybrid direct carbon fuel cells (HDCFC) 218
- hydrofluoric acid (HF) 56
- hydrogen evolution reaction (HER) 153, 167, 225
- hydrogen oxidation reaction (HOR) 157–159
- hydrogen sulfide (H₂S) 134
- hydrophobic–hydrophilic repulsions 31
- hydroquinone-based (HQ) layers 268
- i**
- indium cyclopentadienyl (InCp) 79
- indium oxide (IZO) 73
- indium sulfide (In₂S₃) 114
- indium tin oxide (ITO) 135, 234
- infrared spectroscopy 10
- infrared spectrum 101
- in situ* mass spectroscopy 10
- interdigitated back-contact (IBC) 46, 65
- intermediate band (IB) 109, 114
- intermediate band photovoltaics (IBPV) 114
- ionized impurity scattering (IIS) 70
- IR surface spectroscopy 15
- isoelectric points (EIP) 126
- k**
- Knudsen diffusion 19, 31
- l**
- Langmuir's law 24
- layer-by-layer method 105
- Li–Al–O (LiAlO₂) 190
- Li–Al–Si–O 191
- Li–La–O 189
- Li₂CO₃ 189
- Li₃N 192

- Li_3PO_4 192
 $\text{Li}_x\text{Si}_y\text{O}_z$ 191
 LiCoO_2 195
 LiF 194
 LiFePO_4 197
 light absorption efficiency (η_a) 101
 LiNbO_3 192
 LiPON 193
 LiTaO_3 192
 lithium lanthanum titanate (LLT)
 189–190
 low pressure CVD (LPCVD) 73, 77
 low-temperature epitaxy 109
 LUMO 184
- m**
- macroscopic test structures 20
 Masetti model 70
 mass spectroscopy 26
 membrane electrode assembly (MEA)
 157
 MEMS fabrication techniques 21
 mesoporous silica membrane 31
 metal oxides 229
 metal-assisted chemical etching (MaCE)
 232
 methanol/ethanol/formic acid oxidation
 reaction (MOR/EOR/FOR)
 153, 159–164
 microwave plasma 27
 mixed ionic-electronic (MIEC) 216
 $\text{MnO}_x/\text{Li}_2\text{Mn}_2\text{O}_4/\text{LiMn}_2\text{O}_4$ 196
 molecular layer deposition (MLD) 267
 molten carbonate (MC) 209
 molten carbonate fuel cells (MCFC)
 210
 molybdenum oxide (MoO_x) 89
 Monte Carlo (MC) model 24, 27, 28
- n**
- nanocylindrical arrays 238
 nanonets (NNs) 235
 nanoparticles
 architectures 129
 DSCC 127
 size distribution 105
 nanoscale 262
 nanosphere lithography 214
 nanostructured solar cells
 absorber/HTM interface 130–132
 atomic layer deposition 132–134
 blocking layer, 126–130 134–138
 compact layer 121–126
 nanotube/nanowires 134
 nitric acid oxidation step (NAOS) 82
 nitrides 230
 NW arrays 135
- o**
- octadecyltrichlorosilane (ODTS)
 173
 OES, *see* optical emission spectroscopy
 (OES)
 Ohm's law 82
 OPAL2 70
 open-circuit-voltage (OCV) 214
 optical emission spectroscopy (OES)
 10, 15–16, 26
 organic solar cells 120
 oxygen evolution reaction (OER) 225
 oxygen evolving complex (OEC) 225
 oxygen reduction reaction (ORR) 153,
 164–167
 oxygen transmission rate (OTR) 132
 oxygen vacancies (V_O) 241
- p**
- partial metallization 84
 passivated emitter rear contact (PERC)
 44
 passivating contacts 47, 82
 passivation effect 19
 PbS 113
 perovskite solar cells 120
 phonon mean free path (l) 261
 phonon velocity (v) 261
 phonon-boundary-scattering 266
 phosphoric acid fuel cell (PAFC) 209
 photoconductance (PC) 51
 photocorrosion protection
 nanostructured photoelectrodes
 246
 planar photoanodes 244
 planar photocathodes 246

- photoelectrochemical cells (PEC) 120, 138
 catalyst deposition 239
 coating and functionalization 233
 micro- and nanostructuring 230
 nanostructured photoelectrodes 235
 passivation and modification 240
 photocorrosion protection 244
 photoelectrode materials 228
 principle of 227
 synthesize electrodes materials 234
- photoelectrode architecture 237
- photoelectrode materials
 elemental and compound
 semiconductors 229
 metal oxides 229
 nitrides 230
- photoelectrode/electrolyte junction 241
- photoluminescence (PL) 51
- photonic band gap 30
- photosensitizer 120
- photovoltaic (PV) 43
- photovoltaic conversion efficiency (PCE) 119
- physical deposition methods 108
- physical vapor deposition (PVD) 4, 59, 240
- planar FTO 141
- Planck's constant 70
- plasma-enhanced (PE) 59
- plasma-enhanced ALD (PE-ALD)
 advantages 10
 configurations 9
 conformality 24–29
 reactions 10
- plasma-enhanced chemical vapor deposited (PECVD) 50
- p-n junction model 232
- point contact approach 106
- poly-dimethyl-siloxane (PDMS) 137
- polycarbonate filter 29
- polycrystalline films 125
- polymeric proton-conducting membrane (PEM) 151
- polystyrene (PS) 235
- polytetrafluoroethylene (PTFE) 155
- post deposition anneal (PDA) 50
- potentiostatic stability tests 245
- power efficiency (η_p) 103
- proton electrolyte fuel cell (PEFC) 218
- proton exchange membrane fuel cell (PEMFC) 209
- Pt alloy nanoparticle
 PtCo 170
 PtRu 170
- Pt electrocatalysts, ALD of
 core/shell NPs 172–173
 electrochemical performance 157–167
 fabrication and microstructure 154–157
- pulsed laser deposition (PLD) 70
- q**
- QCM, *see* quartz crystal microbalance (QCM)
- QD, *see* quantum dots (QD)
- QD FET transistor 133
- QD sensitizers 235
- QDSSCs, *see* dye-sensitized solar cells (DSSCs)
- quadrupole filter 13
- quadrupole mass spectrometry (QMS) 13–14
- quantum dot sensitized solar cells (QDSSC) 113, 120, 133
- quantum dots (QD) 113, 132
- quantum efficiency 232
- quartz crystal microbalance (QCM) 12–13
- quasi Fermi levels 48, 50
- r**
- radical-assisted ALD 10
- radio-frequency (RF) coil 10
- random polarization 101
- random-pyramid (RP) 64

- reactive plasma deposition (RPD) 70
- reversible hydrogen electrode (RHE) 161
- S**
- Sb₂S₃ 113
- scanning electron microscopy (SEM) 17, 28
- scanning transmission electron microscopy (STEM) 160
- SE, *see* spectroscopic ellipsometry (SE)
- Seebeck coefficient (*S*) 260, 266
- self-assembled monolayers (SAMs) 173
- Shockley–Queisser limit 103, 109
- Shockley, Read, and Hall (SRH) equation 49, 50, 52
- Si heterojunction solar cells
 - compatibility 74
 - lateral conductivity 69–71
 - transparency 71–74
- Si homojunction solar cells
 - ALD Al₂O₃ 54–59
 - ALD passivation schemes 63–68
 - solar cells manufacturing 59–63
 - surface passivation 48–54
- Si solar cell processing 58
- signal/noise ratio 15
- silicon heterojunction (SHJ) 46, 68
- skutterudites 261
- SnS 113
- solar cells 44, 241
 - efficiency 126
 - nanostructuring of 142
 - performance and stability of 143
 - perovskite 142
 - p-i-n design of 109
 - third generation 127
- solar fuels 225
 - production efficiency 229
- solar light absorbers
 - ETA cells 107
 - light harvesting and charge extraction 105–106
 - low-temperature epitaxy 109
 - pinhole-free ultrathin films 107
 - stoichiometry and doping 107–109
 - uniformity and precision 104–105
- solid electrolyte (SO) 209
- solid electrolyte interface (SEI) 183
- solid oxide fuel cells (SOFC) 209
 - ceria-based materials 214–215
 - gallate materials 215
 - zirconia-based materials 213–214
- solid-state dye-sensitized solar cells (sDSSC) 230
- space-charge region (SCR) 51
- spatial ALD (S-ALD) 60, 80
- spectroscopic ellipsometry (SE) 14–15, 19
- Spiro-OMeTAD 134
- stoichiometric semiconductor 108
- stoichiometry 107
- strontium titanate (STO) 83
- subnanometer
 - films 130
 - scale 120
- successive ionic layer adsorption and reaction (SILAR) 105
- supercycle approach 75, 76, 80
- superlattice period 267
- surface recombination velocity (SRV) 51
- surface-to-volume ratio 50, 132
- synchrotron 16
- t**
- technology readiness level (TRL) 226
- tetrakis-dimethylamidotitanium (TDMAT) 31, 33, 245
- tetrakisdimethylamido tin (TDMASn) 135
- thermal ALD 8, 68, 87
- thermal conductivity (κ) 260
- thermodynamic equilibrium 48
- thermoelectric (TE)
 - designing and optimizing 260
 - energy conversion and cooling 259
 - oxide thin films 263
 - performance 266
 - power factor 264
 - selenide and telluride thin films 266
- thin film deposition 12

- thin film electroluminescence (TFEL) 212
- thin-film thermoelectric devices 262
- TiCl₄ and H₂ plasma 10
- time-domain thermoreflectance (TDTR) 268
- titanium tetraisopropoxide (TTIP) 245
- transition metal oxides (TMOs) 174
- transmission electron microscopy (TEM) 17, 56
- transparent conductive oxide (TCO) 43, 121, 134
- traps 121, 126, 130, 133, 140, 242
- trimethylaluminum (TMA) 10, 54, 156, 241
- 3D photonic crystals 30
- tungsten trioxide 242
- tunnel 47, 80–84, 86, 87, 133, 244
- tunneling 83, 86–87, 121, 128, 132, 243, 245
- tunnel oxide passivated contact (TOPCon) 47
- u**
- ultraviolet (UV) radiation 55 photons 10
- v**
- valence band (VB) 227
- vanadyltriisopropoxide (VTIP) 12
- vapor transport method (VTM) 135, 238
- V₂O₅ 194
- w**
- water (photo)splitting 138–142, 233
- water vapor transmittance rate (WVTR) 132
- Wiedemann–Franz law 260
- wireless cell 231
- x**
- x-ray absorption near edge structure (XANES) 160
- x-ray absorption spectroscopy (XAS) 241
- x-ray diffraction (XRD) 16
- x-ray fluorescence (XRF) 16, 31
- x-ray photoelectron spectroscopy (XPS) 16
- x-ray reflectivity (XRR) 16, 32, 268
- y**
- yttria-doped ceria (YDC) 214
- yttria-stabilized zirconia (YSZ) electrolyte 210
- z**
- zintl phases 261
- ZnO nanorod (ZnO-NR) 130, 162
- ZrO₂ powder 15
- Z-scheme 227

