

Index

a

advanced characterization techniques 256

advanced imaging techniques 256

algin 162

aluminum-plastic film 246

amine compounds 96

annular-bright-field (ABF) 262

anode materials 117

- host-zinc interface 141–147
 - building zincophilic sites 142–144
 - hydrogen evolution barrier layer 144–145
 - interface orientation regulation 145–147
 - uniform conductive host 141–142
- interface layer 133
 - complex layer 138–141
 - electron-oriented layer 136–137
 - insulating layer 133–136
 - ion-oriented layer 137–138
- surface modifications 125–147
 - electrochemical protocol to uniformize surface 129–131
 - high-performance surface 128–129
 - physically and chemically polished surface 131
 - plasma-treated surface 132–133
 - textured surface 132
 - zinc-electrolyte interface 128–141
- 3D zinc anodes 118–120

- zinc alloy anodes 120–121
- zinc-plated hierarchical anodes 121–125
 - metal-organic frameworks 124
 - 3D carbon-based hosts 121–124
 - 3D metallic host 124
- aqueous electrolyte
 - advantages 242–243
 - limitations 243–244
 - matching principle 244
- aqueous Zn-ion batteries (AZIBs)
 - anode 3–4
 - assembly and practical application 6
 - cathode 2–3
 - challenges 2–6
 - electrolytes 5–6
 - history 1–2
 - separator 4–5
- assembly process
 - anode flake 238–242
 - cathode flake 235–238
 - coin cell 245
 - electrolyte 242–245
 - soft-packed cell 245–247
- atomic force microscope (AFM) 23, 127, 257, 264–267, 269, 288–291, 301

b

battery internal resistance (R_i) 232

1,4-bis(diphenylamino)benzene (BDB) 96–98

c

capacity (*C*), battery's 232–233
 carbonyl compounds 94, 95, 98
 cathode 2
 chemical conversion 13–20
 electrochemical reaction mechanism
 9–20
 Co-insertion/extraction mechanism
 11–13
 Zn²⁺ insertion/extraction mechanism
 9–11
 cation doping 59, 77
 cation vacancy 57, 59
 characterization techniques 124,
 256–292, 299, 301, 306
 apparent and morphological
 observations 257–270
 chemical reaction process 164, 243, 282
 coating, battery field 235
 coin cell 6, 228–230, 245, 305, 307
 conductive polymers 49, 52, 80, 98, 100
 constant current discharge 233
 copper-based materials 141
 crystal facets/nuclei
 epitaxial growth 28–29
 preferred orientation growth 29
 surface diffusion and lattice
 incorporation 27–28
 cylinder cell 230–231

d

deep eutectic solvents 164–166
 depth of discharge (DoD) 122, 233–234,
 251
 discharge voltage 98, 102, 104, 232, 233

e

electrochemical stability window (ESW)
 158, 159, 164, 242
 electrolytes
 concentration 158–160
 corrosion and dendrites growth
 184–185
 corrosion and passivation 174–177
 dendrite growth 178–184

 development of 153–166
 functional additives 155–158
 issues and solutions of 166–185
 cathode dissolution 167–171
 water decomposition 171–174
 electromotive force (EMF) 174, 231, 232
 electron microscope (EM) 195, 257–267
 electron paramagnetic resonance (EPR)
 271, 284, 285
 electrospray ion source (ESI) 284
 electrostatic potential (ESP) method
 297–300
 energy density 104, 234
 low 102
 organic materials 103–104
 Eos Energy Storage 251
 epitaxial growth 28–29, 132, 147

f

Fourier transform infrared spectrometer
 (FTIR) 84, 275–277, 286–287, 301

g

galvanized materials 241
 galvanostatic intermittent titration
 technique (GITT) 63, 64, 82
 gel electrolyte (GE) 162, 163, 181,
 218–219, 244–245, 307
 gel-polymer electrolytes 162
 glass fiber (GF) 4, 5, 194–195, 217, 307
 separators 307
 graphene-like carbon films (GCFs) 122

h

HanShu technology 248
 Hanwei technology 247–248
 heterogeneous nucleation 23–24
 high-angle annular-dark-field (HAADF)
 262
 hydrogel electrolyte 160–163, 175, 176,
 218, 245, 252

i

indole 96–99
 inorganic carbon materials 49

- in-situ AFM 288–291
- in situ characterization techniques 286
- AFM 288–291
 - FTIR 286–287
 - optical microscopy 291–292
 - Raman spectroscopy 288
 - XRD 287–288
- in-situ FTIR 286–287
- in-situ optical microscopy (OM) 291–292
- in-situ Raman spectroscopy 288
- in-situ synthesis 237
- in-situ techniques 256
- in situ XRD technology 287
- ionic liquids 163–165
- IR analysis 275
- k**
- ketones 94, 95
- l**
- laser scanning confocal microscope (LSCM) 267–269
- lighter carbon-based material 205
- lithium-ion batteries 1, 2, 9, 44, 135, 153, 193, 228–231, 248, 250, 255, 307
- m**
- manganese-based cathode materials 33
- compositing with conductive materials 49–52
 - defect engineering 57–60
 - dissolution 44
 - electrochemical activation 60–61
 - layered (δ -) MnO_2 39–40
 - poor electrical conductivity 45–46
 - pre-intercalation 52–57
 - spinel (λ -) MnO_2 40–42
 - structural instability 44–45
 - structure design
 - 0D–3D nanostructure 46–49
 - porous and hollow 49
 - tunnel-type structure 33–39
- manganese monoxide (MnO) 33, 42, 43, 59, 61, 288
- metal-organic frameworks (MOFs) 121, 124, 143, 198, 212
- micro-computerized tomography (micro-CT) 269, 270
- α - MnO_2 9–11, 14, 33–37, 39
- molding method 239
- $\text{M}_x\text{V}_2\text{O}_5 \cdot n\text{H}_2\text{O}$ 63
- $\text{M}_x\text{V}_3\text{O}_8$ 64
- mxene/graphene aerogel (MGA) 122, 124
- n**
- NaCl-type structure 72
- $\text{NaTi}_2(\text{PO}_4)_3$ (NTP) 299, 300
- neutron pair distribution function (PDF) analysis 70, 71, 256
- novel functional separators 307
- nuclear magnetic resonance (NMR) spectroscopy 280–282
- o**
- open-circuit voltage (V_{OC}) 88, 228, 232
- organic additives 155, 157, 177, 179, 181, 184, 243
- organic materials 93
- bipolar-type compound 99–100
 - cycling stability 104–105
 - electronic conductivity 102–103
 - energy density 103–104
 - high performance 102
 - low energy density 102
 - n-types 94–96
 - poor cycling stability 102
 - poor electrical conductivity 100–102
 - P-types 96–99
 - types 94–96
- organic radical polymers 98
- oxygen defects 12, 56, 75, 76
- oxygen vacancy 57, 59, 75, 76
- p**
- parasitic reactions 170, 305, 306
- polar organic molecules 207
- polyacrylamide 161, 162, 245, 295
- polypropylene (PP) 194, 203, 246

- polypyrrole (PPy) 52, 53, 96, 97, 99
 polyvinylidene fluoride (PVDF) 162,
 163, 211, 239, 240, 272
 power density 5, 80, 193, 194, 234–235,
 305
 pre-encapsulation 246
 prismatic cells 229–231, 307
 Prussian blue analogs (PBA)
 crystal structure design 89, 91
 metal-substitution and morphology
 design 91
 structure and categorization 89
 surface modification 92–93
 synthesis method 89
- q**
- quasi-solid gel electrolytes 307
 quinones 94, 95
- r**
- Raman spectroscopy 13, 256, 272–275,
 288
 Rechargeable Hybrid Aqueous Battery
 (ReHAB) technology 249
 Rocksalt-type structure 72–73
 rolling 129, 131, 231, 235–237, 241, 245,
 248
 Ruihai Lake (Qingdao) Energy
 Technology Co., Ltd 249–250
- s**
- Saccharin 158
 Salient Energy 250
 scanning electron microscope (SEM) 5,
 54, 83, 125, 143, 144, 146, 147, 163,
 180, 195, 200, 204, 209, 256–262,
 301
 scanning Kelvin probe microscope
 (SKPM) 269, 270
 Scherrer formula 29
 separator 191, 307
 commercial 194–196
 cellulose 195–196
 glass fiber 194–195
 nafion 196
 polyolefin 194
 constructing high performance
 196–217
 accelerating Zn²⁺ transport
 207–213
 conductive layer 203–206
 homogeneous ion distribution
 promote 196–206
 ordered pore structure constructing
 197–203
 electrostatic interaction 211–212
 Maxwell–Wagner polarization
 212–213
 performance requirements of
 chemical and electrochemical
 stability 191–193
 mechanical strength 192
 wettability/electrolyte
 uptake/electrolyte retention 192
 properties requirements
 pore distribution 193
 pore size 192–193
 porosity 193
 thickness 193
 zincophilicity 207–211
 Zn growth direction 213–217
 crystallographic orientation
 213–216
 lateral growth 216–217
 separator free 218
 gel electrolyte 218–219
 solid electrolyte 219–222
 simulations 292
 of electric field distribution 292–293
 of Zn²⁺ concentration field distribution
 293–295
 sintering method 239
 slurry method 235, 238, 239
 soft-packed cell 245
 aluminum-plastic film 246
 cell preparation 245–246
 electrode forming 245
 formation and baking 246–247
 injection 246
 pre-packed 246

- subsequent process 247
 - tab connection 246
 - vacuum packed 247
 - soft-packed cells 229–230, 245–248
 - space charge-induced nucleation 25–27
 - spinel (λ -) MnO_2 33, 40–42
 - STEM 256, 257, 262–264, 301
 - surface diffusion and nucleation 24–25
 - synergistic effects 86, 306
- t**
- test molds 227–228
 - tetragonal spinel- Mn_3O_4 (MnMn_2O_4) 41
 - theoretical capacity (C_0) 2, 33, 102, 104, 153, 232–233
 - theoretical research methods
 - calculations 295–297
 - simulation 292
 - 3D metal networks 124
 - 3D zinc anodes 118–120, 242
 - todorokite-Type MnO_2 33, 39
 - transmission electron microscope (TEM)
 - 51, 83, 86, 93, 145, 256, 257, 261–264, 301
- v**
- vanadium-based compounds 61
 - composite 85–86
 - defect engineering 75–77
 - dissolution 74–75
 - distorted octahedron/regular octahedron 62
 - electrochemical activation 86–88
 - electrostatic interactions 74
 - H_2O intercalation 80
 - interlayer intercalation 77–83
 - ion intercalation 77–78
 - layered structure 62–67
 - morphology optimization 83–85
 - NASICON-type structure 70–72
 - polymer intercalation 80–83
 - Rocksalt-type structure 72–73
 - spinel-type structure 70
 - tetrahedron 62
 - trigonal bipyramid and square pyramid 62
 - tunnel-based structure 67–70
 - vanadium nitride (VN) 72
 - vertical graphene (VG) carpet 293
 - V_2O_5 , vanadium-based cathodes 63
- w**
- “water-in-salt” electrolyte 169
 - working voltage (V) 17, 20, 83, 232, 243, 244
- x**
- X-ray absorption fine structure (XAFS) 282
 - X-ray absorption near-edge structures (XANES) 34, 35, 282, 283
 - X-ray absorption spectroscopy (XAS) 256, 282, 284
 - X-ray diffraction (XRD) 10, 34, 215, 256, 271–272
 - of electrode materials 256
 - structural characterization techniques 271–272
 - X-ray photoelectron spectroscopy (XPS) 10, 13, 42, 43, 57, 61, 65, 70, 87, 90, 177, 183, 209, 210, 256, 271, 276–280
 - xanthan gum 161–163
- z**
- zinc alloys 118, 241
 - anodes 120–121
 - zinc anodes, utilization of 305
 - zinc deposition reaction 21
 - crystal facets/nuclei 27–29
 - nucleation 21–27
 - zinc foil, in AZIBs 3–4
 - zinc metal anode 4, 20–29, 117, 120, 121, 128, 129, 139, 141, 145, 183, 247, 306
 - thermodynamics 20–21
 - zincophilicity 22, 142, 203, 205, 207–211, 295–297

- zinc plate 118, 121–125, 145–147, 183, 238, 240–241
- zinc-plated hierarchical anodes 118, 121–125
- 3D carbon-based hosts 121–124
- zinc powder 29, 119, 238–240
- zinc sulfate 1, 21, 34, 37, 41, 132, 159, 162, 244, 262
- Zn²⁺ diffusion kinetics 207, 297–299

