

Index

a

ABX₃ perovskite structure 342
 acid-base blends 158
 Aciplex-S[®] 170
 Al-ion capacitors (AICs) 284
 alkaline battery 96, 103, 107, 108
 1-alkyl-3-methylimidazolium
 bis(trifluoromethylsulfonyl)
 imide 11, 139, 140, 382
 alternating current (*ac*) signal 24, 27,
 28, 63
 amorphous carbon nanotube (α CNTs)
 systems 77
 asymmetric supercapacitor 279–281
 auxiliary-power-units (APU) 100

b

Baghdad battery 95, 96
 Bandara-Mellander (B-M) method
 53–57
 Barrett-Joyner-Halenda (BJH) method
 258
 BatCap systems 281
 benzophenone (Bp) 10, 156
 blend polymer electrolytes 5
 block copolymer electrolytes (BCEs) 6
 Brunauer, Emmett and Teller equation
 256
 1-butylpyridinium tetrafluoroborate
 (BPBF₄) 75, 77

c

capacitor 7, 28–32, 37, 39, 48, 53,
 57, 95, 99, 100, 124, 125, 221,
 232

carbonaceous electrodes 153, 239
 carbon dots enhance light harvesting
 326
 carbon nanotubes (CNTs) 12, 14, 77,
 125, 153, 155, 235, 267, 327,
 340
 ceramics electrolyte 3
 cerium dioxide (CeO₂) 367
 cerium-titanium dioxide (CeO₂-TiO₂)
 367
 charge-discharge method 258, 260
 chemical energy 100, 123, 150, 156,
 300, 331
 chemical gels 190
 chitosan (CS) 3, 7, 115, 124, 126,
 139–141, 149, 150, 158, 162, 163,
 369, 372, 373, 377
 commercial ECWs 366
 complex impedance plane plot 25
 composite polymer electrolytes (CPEs)
 3, 12–17, 73, 121, 241, 383–385
 composite-type supercapacitors 280,
 284
 concentration polarization 151, 194,
 207
 constant phase element (CPE) 37, 57,
 60, 216, 259
 conventional battery 120–123
 conventional IS technique 25
 copolymer 6–8, 11, 12, 114, 128, 143,
 170, 191, 244
 copper phthalocyanine (CuPc) 326
 copper zinc tin sulfide solar cell (CZTS)
 99
 cross linking PEs 6

cyclability 151, 156, 203, 205, 217
 cyclic voltammetry (CV) 166, 258,
 259–260

d

degradable batteries 121
 device fabrication 189, 354–355
 dextran gelator based hydrogel
 polysulfide electrolyte 325
 diethyl carbonate (DEC) 9, 120, 138,
 190, 243
 differential scanning calorimetry (DSC)
 apparent melting at T_g 83–84
 artificial 82, 83
 bare and doped SPEEK membrane
 79, 81
 α CNTs 77
 EMIBF₄ and BPBF₄ 75, 77
 ethylene carbonate (EC) 77
 experimental phenomena 86
 gellan and LiCF₃SO₃ 79, 80
 of Li-SPE 76, 78
 lithium hexafluorophosphate (LiPF₆)
 77
 p(EEO-AGE)-based electrolytes
 p(EEO-AGE)LiClO₄ 78, 79
 p(EEO-AGE)-based electrolytes
 p(EEOAGE)LiTFSI 76, 79
 PEO 76, 79
 PET 84, 86
 p(EEO-AGE)LiClO₄ 78
 p(EEO-AGE)LiTFSI 78
 pure and lithium-doped SPEEK
 membranes 81
 transition(s) at 0°C 83
 diffuse model 234
 diffusion impedance 39–40, 154
 dimethyl carbonate (DMC) 2, 9, 120,
 144, 190, 208, 212, 243
 dimethyl formamide (DMF) 143
 direct current (*dc*) 24
 direct methanol fuel cell (DMFCs)
 123, 156
 discharge capacitance (C_d) 261
 disordered carbon (DC) 283
 double-layer capacitors 7, 53, 124
 dry cell 94, 95, 201

DryLyte solid-state battery 173
 dry solid polymer electrolytes
 138–141
 dual carbon battery 220
 dual graphite battery 220
 dye sensitized solar cells (DSSCs) 99,
 127, 148, 174, 302
 dynamic mechanical analysis (DMA)
 66, 87

e

1-ethyl-3-methylimidazolium
 tricyanomethanide (EMImTCM)
 11, 12
 electrical conductivity 26, 146, 267,
 269
 electrical double cylindrical capacitor
 (EDCC) 235, 236
 electrical double layer (EDL) 7, 54,
 152, 232, 235
 electrical double layer capacitors
 (EDLCs) 100
 AC-based 263
 carbon nanotubes (CNTs) 267
 charge storage mechanisms 233,
 236, 238, 255
 graphene-based materials 269
 electric double layer (EDL) 54, 55, 57,
 58, 124, 152, 153, 233, 235
 electricity energy 300
 electrochemical impedance
 spectroscopy (EIS) 48, 258–259
 electrochemical stability window (ESW)
 12, 116, 120, 144, 171, 219, 239,
 241, 254, 370
 electrochromic devices (ECDs) 114,
 125–127, 163, 164, 166, 167, 317,
 365, 369–370
 electrochromic windows (ECWs) 172,
 173
 commercial 366
 electrochromic electrodes 367–368
 electrochromic materials 366
 ion conductor 367
 mechanism of 368–369
 polymer electrolytes for
 background 369

- composite 383
 - electrochromic device 369–370
 - future aspects 385
 - GPEs 374–383
 - SPE 370–374
 - principles and working process of 366–367
 - schematic diagram of 367
 - electrochromism 163, 365
 - electrolyte/electrode (E/E) interface 32, 33, 37–39, 41, 57, 270
 - energy demand 299, 316, 318, 332
 - energy resources 299–301, 331
 - energy storage devices (ESDs) 120, 146, 152, 188, 231, 252, 269, 284
 - energy supply 299–300
 - ethylene carbonate (EC) 2, 9, 65, 77, 120, 138, 190, 208, 212, 242, 321–323, 375
 - ethylene diamine tetraacetic acid (EDTA) 216, 217
 - ethyl methyl carbonate (EMC) 2, 120, 146, 190
 - 1-ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide (EMImTFSI) 151, 156
 - 1-ethyl-3-methylimidazolium tetrafluoroborate (EMIBF₄) 75, 77, 241, 246, 247, 264
 - 1-ethyl-3-methylimidazolium tetrafluoroborate (EMIMBF₄) 172, 265, 380, 381
 - ethyl methyl imidazolium thiocyanate (EMImSCN) 150
 - ethyl methyl imidazolium fluoro sulfonimide (EMIFSI) 125, 146, 154–156
 - EU Regulation (EG) Act 1272/2008 171
- f**
- Faradaic charge storage mechanism 236
 - film capacitor 95, 99
 - first-generation solar cells 97, 301
 - Flemion[®] 170
 - fluorine-doped tin oxide (FTO) 164, 314
 - fluorine tin oxide (FTO) 366
 - fossil fuels 123, 187, 299–301
 - free volume theory 118, 208
 - fuel cells 1, 7, 87, 93, 95, 100, 116, 123–124, 156–163, 174–175
 - fuel cell vehicles (FCV) 100, 101
- g**
- galvanic cell 94
 - galvanostatic charge-discharge 261, 262, 266, 270, 271, 273, 277, 278
 - γ -butyrolactone (GBL) 142, 208, 212, 349, 371
 - gel electrolytes (GPEs) 125, 142, 171, 174, 187, 195, 244, 265, 267, 274–278, 318, 319, 324, 325, 328, 329
 - gel/plasticized PEs (GPEs) 65
 - gel polymer electrolytes (GPEs) 8
 - flammability 193–194
 - formability/contact with electrodes 193
 - future aspect 196
 - ionic conductivity and mechanical properties 192–193
 - ionic liquids (ILs) 144–146
 - LIBs 215
 - nanomaterials 146
 - PAN 141–143
 - PEO 141
 - phthaloylchitosan 141
 - PMMA 141
 - polymer matrix 190
 - PVdF 141
 - PVdF-HFP 141, 143
 - supercapacitors
 - ionic liquids 244
 - organic solvents 243
 - plastic crystals 247
 - redox-active 251
 - gel theory 208
 - Goldschmidt tolerance factor 344
 - Gouy-Chapman Double Layer 234
 - Gouy-Chapman model 233–235
 - graphene-based EDLCs 265, 269–270

- graphene implanted polyacrylamide gel
 - electrolytes 328–329
 - Grotthuss mechanism 118
 - guanidinium-based PILs 12
 - guanidinium ionic liquid 12
- h**
- Helmholtz double layer 100, 233
 - Helmholtz model 233, 234
 - highest occupied molecular orbital (HOMO) 341
 - hole transport layer (HTL) 354, 355
 - hot casting process 352
 - hybrid capacitors 100, 260, 281, 283
 - hybrid electric vehicles (HEVs) 101, 150
 - hybrid supercapacitors 279
 - Al-ion capacitors 284
 - BatCap systems 281
 - LIC 281–282
 - NICs 282–284
 - hydrocarbon membranes 158
 - hydro-gel electrolyte with polyacrylamid 318–319
 - hydropower 300
 - hydroxypropyl cellulose (HPC) 126, 166, 182, 369, 370, 378
 - hydroxy propylcellulose (HPC)-based electrolyte 126
- i**
- impedance plots 25
 - bulk resistance 49–50
 - conductivity calculation of 59–60
 - definition of 26
 - impedance plots of circuits
 - capacitance 28
 - combined series and parallele circuits 31
 - electrolyte sandwiched between two blocking electrodes 33
 - electrolyte sandwiched between two non-blocking electrodes 32
 - polycrystalline electrolyte 33–35
 - R and C connected
 - in parallel 30
 - in series 29
 - resistance 28
 - impedance spectroscopy (IS)
 - accuracy check 48–49
 - bulk resistance 49–50
 - causality 28
 - CPE 37
 - data interpretation and analysis 49–63
 - diffusion/mass transport impedance 39–40
 - electrical conductivity 26
 - electrolyte/electrode (E/E) interface 39
 - equivalent circuit,
 - electrolyte/electrode system 42
 - equivalent circuits, real systems 37–39
 - experimental results and analysis 59–63
 - frequency range and number of readings 49
 - immittance functions
 - choice between 46
 - definition 43
 - relationship between 43
 - immittance plots 43
 - impedance plot of circuits 28
 - linearity 27
 - principles of 23–25
 - sample and cell arrangement 47
 - solid electrolyte 35–36
 - stability 27–28
 - transport parameters
 - Bandara-Mellander (B-M) method 53–57
 - Nyquist plot fitting method 57–59
 - Warburg impedance 40–41
 - incident photon-to-electricalconversion efficiency (IPCE) 355
 - indium-doped tin oxide (ITO) 164
 - indium tin oxide (ITO) 126, 366, 369
 - infinite Warburg impedance 41
 - inner Helmholtz plane (IHP) 234
 - inorganic ceramic solid electrolytes 14
 - inorganic salts 247

- intercalation pseudocapacitance
236–238, 271
- International Energy Outlook 2016
(IEO2016) 299
- ion-exchange capacity (IEC) 124
- ionic liquids (ILs) 8, 9, 12, 75, 116, 117,
124, 138, 140, 144–146, 194, 196,
202, 239–241, 243–246, 250, 263,
267–269, 276, 285, 374, 379, 380,
382
- ionic liquid gel polymer electrolytes
(ILGPEs) 144–146
- iridium hydroxide $\text{Ir}(\text{OH})_3$ 165
- Irvine battery 221
- k**
- Konjac glucomannan (KGM) 324
- Kramers-Kronig (KK) transformation
relations 27
- l**
- lead acid batteries 94, 95, 103–104,
109, 110, 231, 281
- Leclanche cell 94, 96
- Leyden jar 99
- $\text{Li}_{1.5}\text{Al}_{0.5}\text{Ge}_{1.5}(\text{PO}_4)_3$ (LAGP) 16
- $\text{Li}_{10}\text{GeP}_2\text{S}_{12}$ (LGPS) 17
- light-emitting diodes (LEDs) 128, 155,
300
- light-emitting electrochemical cells
(LECs) 128–129
- Li ion batteries
graphite and LiCoO_2 1
structure of 1
- Li-ion capacitors (LICs) 281–282
- $\text{Li}_7\text{La}_3\text{Zr}_2\text{O}_{12}$ (LLZ) 16
- limiting oxygen index (LOI) 144
- linear sweep voltammetry (LSV) 255
- Li-PEO type polymer electrolyte 194
- liquid electrolytes (LEs) 149, 167, 188,
219
supercapacitors 239
- lithium-air battery 220
- lithium bis(oxalate)borate (LiBOB) 60,
219
- lithium
bis(trifluoromethane)sulfonimide
(LiTFSI) 71
- lithium difluoro(oxalato)borate
(LiDFOB) 151
- lithium-doped SPEs 114
- lithium hexafluorophosphate (LiPF_6)
71, 76, 77, 115, 138
- lithium ion batteries (LIBs) 65, 97, 105,
150
discharge capacity in 218
future aspects 195, 219
gel electrolytes 187
GPE 215
liquid electrolyte in 218
liquid electrolytes 188
PEO-LiBNFSI 219
performance and improvements
190–194
performance characteristics of
216–217
polymer 194–195
solid electrolytes 188
solid polymer electrolytes 208
structure and operation of
anode materials 204–205
cathode materials 205–206
cyclability 203
discharging and charging rates
203–204
electrolyte 206
ion transport equations 206–207
specific capacity 203
specific energy 203
- lithium-ion polymer battery (LiPo) 97
- lithium polyethylene glycol (LPEG) ions
8
- lithium-silicon battery 221
- lithium-sulphur battery application 74
- lowest unoccupied molecular orbital
(LUMO) 341
- lubricity theory 208
- m**
- mass transport impedance 39–40
- mesoporous carbons 220, 235, 282
- mesoporousstructured solar cells 340

- metal organic frame work (Mg-BTC) 71
- methylammonium lead iodide (MAPbI₃) 339
- methylammonium lead iodide (CH₃NH₃PbI₃) perovskite 349
- micropores 8, 153, 235, 236, 258, 263
- micro-porous PEs (MPEs) 65
- mixed transition metal oxides (MTMOs) 270, 277, 278
- mobile power
 - history development
 - Baghdad battery 94, 96
 - capacitors 99
 - dry cell concept 94, 95
 - first wave of 94
 - fuel cell 100
 - gasoline-and diesel-powered vehicles 102
 - hybrid cars 101, 102
 - lead acid 94
 - Leyden jar 99
 - LIB 97
 - LiPo 97
 - nickel-iron battery (NiFe) 95
 - renewable solar energy 96
 - second wave of 94
 - solar cells 97, 99
 - supercapacitor 100
 - timeline of 94
 - voltaic battery 96
 - lead-acid batteries 103–104
 - LIB 105
 - NiCd batteries 104
 - primary battery 103
 - recycling
 - lifecycle of 107
 - primary battery 106–108
 - rechargeable batteries 109–111
 - molybdenum dioxide (MoO₂) 367
 - molybdenum oxide (MoO₃) 164
 - montmorillonite (MMT) 14, 87, 211
 - multiwalled (MWCNTs) 267
 - multiwalled carbon nanotubes (MCWNT) electrodes 153, 154
- n**
 - Nafion® 124, 158, 170
 - Na-ion capacitors (NICs) 282, 283
 - N-alkyl-N-methyl-pyrrolidium bis(trifluoromethansulfonyl) imide 10, 11
 - nanocellulose-laden composite PEs 74, 76
 - Na super ionic conductor (NASICON) 14, 16
 - natural polymers 7
 - polymer electrolytes 3
 - natural polysaccharide 324–325
 - nickel-based batteries 104–105
 - nickel-cadmium (NiCd) battery 95, 201
 - nickel-iron battery (NiFe) 95, 201
 - niobium pentoxide (Nb₂O₅) 367
 - non-aqueous electrolyte 2, 3
 - non-battery technology 221
 - non-fluorinated membranes 157
 - non-polar capacitors 99
 - Nyquist plot 25, 26, 48, 51, 57–63, 154
 - Nyquist plot fitting method 57–63
- o**
 - Ohm's Law 23, 64
 - oligomer gel electrolytes 326–327
 - olivines 205, 282
 - organic ionic plastic crystals (OIPCs) 247, 249
 - organic light-emitting diodes (OLEDs) 128
 - organic plastic crystals 248, 327
 - organic solar cell 99
 - organometallic halide perovskite 339
 - organometallic perovskites 341
 - outer Helmholtz plane (OHP) 234
- p**
 - Paris 2020 agreement 102
 - partially fluorinated polymers 157
 - peanut shell ordered carbon (PSOC) 283
 - PEO-based polymer electrolyte 13
 - perfluorinated polymer 170
 - perfluorocyclo-alkene (PFCA) 157

- perfluorosulfonic acid (PFSA) 124, 157, 159
- perfluorosulfonylimide (PFSI) 157
- perovskite solar cells 99
 ABX₃ structure 342
 challenges and improvement 356–357
 electron injection 341
 future aspect 357
 hole injection 341
 HOMO 341
 I_{\max} and V_{\max} 356
 ionic radii of anions 344
 ionic radii of organic/inorganic molecular cations 345
 IPCE 355
 LUMO 341
 mesoporousstructured solar cells 340
 metal halide 343
 n-i-p and p-i-n type 339
 PCE 339, 340
 photoexcitation 341
 polymer electrolyte 354–355
 R_A , R_B , and R_X 343
 redox electrolyte layer 356
 spectral response of 355
 structure 344
 synthesis of
 hot casting process 352
 solution-processed method 349
 thermal evaporation technique 352
 vapor deposition method 352
- phosphomolybdic (PMA) 163
- phosphotungstic (PWA) 163
- photo-electrochemical solar cells
 charge generation 303, 304
 charge separation 304
 charge transport 304
 electrolyte 304
 n-type semiconductor 304, 306, 307
 photo-sensitized wide bandgap semiconductor 308
 photo-voltage 307
 semiconductor/electrolyte junction 308
- third-generation solar cells 302
- phthaloylchitosan (PhCh) 141, 149, 150
- physical gels-liquid electrolyte 190
- planar solar cells 340, 343
- plastic crystals 243, 247–249, 263, 269, 270, 328
- plasticized PEs 8, 190, 376
- plasticizers 6–11, 83, 115, 118, 189, 190, 192, 193, 202, 206–209, 242
- polar polymers 190, 242
- poly(2-acrylamido-2-methyl propansulfonate) (PAMPSLi) 11, 12
- poly(3,4-ethylenedioxythiophene) (PEDOT) 169
- poly(ethylene oxide) (PEO) 65, 66
 polymer-based electrolytes 241–255
 SPEs 114
- poly(methyl methacrylate) (PMMA) 1, 7, 66, 140, 243, 317, 370
- poly(vinyl alcohol) (PVA) 7, 66, 122, 317
- poly(vinyl chloride) (PVC) 4, 7, 66, 317
- polyacrylamide (PAAm-G) 328
- polyacrylamide (PAM) 156
- poly(acrylonitrile) (PAN)-based polymer electrolyte 7, 321
- polyethylene glycol (PEG) 9, 139, 140, 242, 317
- polyethylene oxide (PEO) 1, 4, 32, 189, 253
- polyethylene terephthalate (PET) 166
- polyethyl imine (PEI) 5
- poly(4,4,4'-tris[4-(2-bithienyl)phenyl]amine) (PTBTPA) films 381
- polymer-based electrolytes
 GPEs
 ionic liquids 244
 organic solvents 243
 plastic crystals 247
 redox-active 251
 PEO 241
 PPEs 252
 salt complexes/solvent-free 241
 solvent-free solid polymer electrolytes 242

- polymer electrolytes (PEs) 65
 - challenges and improvements
 - batteries 171–172
 - DSSCs 169
 - ECW 172
 - EDLCs 172
 - electrolytes 167
 - fuel cell 170–171
 - classification of 3
 - CPEs 12–17
 - dry SPEs 138–141
 - electrochemical devices
 - DSSCs 148–150
 - EDLCs 152–156
 - electrochromic windows 163
 - LIBs 150–152
 - PEFC 156–163
 - future aspects
 - DryLyte solid-state battery 173
 - DSSCs 174
 - electrochromic/smart window technology 173
 - PEMFC 174
 - GPEs 8–12, 141, 190
 - impedance spectroscopy (IS) 23
 - ionic conductivity of 9
 - LIBs 187
 - PAN 7
 - perovskite solar cells 354–355
 - physical, chemical, and
 - electrochemical properties 2
 - physical state and composition 3
 - properties of 137
 - solid 4
 - SPEs 188
 - supercapacitors 232
 - polymer electrolyte-based
 - supercapacitors
 - preparation of 241
 - polymer electrolyte fuel cells (PE) 156–163
 - polymer electrolyte membrane fuel cells (PEMFCs) 123, 124, 158, 174
 - polymer films 6, 252, 382
 - polymeric ionic liquids (PILs) 12, 124
 - polymer lithium ion batteries 194–195
 - polymer matrix(es) 1, 3–5, 8, 11, 12, 17, 70, 71, 73, 113, 119, 120, 189, 190, 192, 196, 215, 219, 244, 317, 318, 324, 325
 - polymer nanocomposite electrolytes (PNCEs) 66
 - Polymer solar cell 99
 - polymethyl methacrylate (PMMA) 1
 - polysulfide electrolyte 318, 324, 325–326
 - polyvinylidene fluoride (PVdF) 2, 124, 143
 - polyvinylidene
 - fluoride-trifluoroethylene or P(VDF-TrFE) 143, 172
 - polyvinylpyrrolidone (PVP) 216
 - porous polymer electrolytes (PPEs) 65, 241, 252–255, 266
 - portable power 93, 232
 - power conversion efficiency (PCE) 322, 325, 327, 328, 331, 339, 340
 - primary battery 102, 103, 106–109, 121
 - propylene carbonate (PC) 9, 120, 138, 190, 208, 212, 240, 322, 366, 382
 - proton exchange membrane fuel cells 123
 - Prussian blue (PB) 126, 163, 166, 367–371, 376, 379
 - pseudocapacitance
 - conducting polymers 272–274
 - Faradaic charge storage mechanism 236
 - intercalation 238
 - intrinsic or extrinsic materials 236
 - redox 237–238
 - solid/quasi-solid-state 272
 - TMOs and mixed TMOs 271, 275
 - underpotential deposition 237
 - pseudo capacitors 100, 232, 276
 - pure lithium battery 221
- q**
- quantum dots (QDs) 302, 310
 - quantum dot sensitized solar cells (QDSSCs)
 - configuration of 315

- light harvesting efficiency 316
 mechanism of 313–314
 nano-structured film preparation
 methods 314
 polymer electrolytes
 advantages 317
 carbon dots enhance light
 harvesting 326
 CdS sensitized cell, PAN and PVDF
 electrolytes 319–323
 dextran gelator based hydrogel
 polysulfide electrolyte 325
 graphene implanted
 polyacrylamide gel electrolytes
 328–329
 hydro-gel electrolyte with
 polyacrylamid 318–319
 12-hydroxystearic acid 329–330
 liquid and solid inorganic
 electrolytes 317
 natural polysaccharide 324–325
 oligomer gel electrolytes 326–327
 PEO and PVDF based electrolyte
 for solid-state electrolytes 329
 sodium polyacrylate polyelectrolyte
 330–331
 succinonitrile 328
 thiolate/disulfide redox couple
 327–328
 ZnO thin films 324
 quantum dots 302, 310
 quantum dot solar cell (QDSSC) 99
 quasi-solid-state QDSSC 318–319,
 324–331
- r**
- rechargeable batteries 98, 102, 103,
 109–111, 138, 187, 201, 231, 236,
 249, 267, 285
 rechargeable solid-state batteries 1
 redox-active polymer electrolytes 265
 redox additives 251, 266, 329
 redox couple 127, 169, 302, 304, 309,
 315, 316, 321, 323, 327–328,
 332–334, 354
 redox pseudocapacitance 236,
 237–238
- relative humidity (RH) detection 128
 renewable solar energy 96
 room temperature ionic liquids (RTILs)
 9, 144, 240
 supercapacitors 240
 ruthenium oxide 237, 238, 275
- s**
- salt-polymer complexes 1, 113
 second generation solar cells 98, 99,
 301
 sequential chemical bath deposition
 (SCBD) method 318, 320
 Shockley-Queisser limit 357
 silicon-tungstic (SiWA) acids 163
 silk-based compact Mg battery 121
 silver mica capacitors 100
 simple ionic layer adsorption and
 reaction (SILAR) process 278
 single walled (SWCNTs) 267, 268
 slit-pore model 235
 smart windows 164, 172, 173, 365, 382
 sodium polyacrylate polyelectrolyte
 330–331
 solar cells 97
 advantages 301
 photo-electrochemical 301–310
 solar energy 96, 173, 174, 300, 383
 sol-gel method 117
 solid electrolyte 3, 14, 16, 32, 35–36,
 50, 128, 137, 151, 167, 169, 187,
 188, 190, 194, 196, 202, 218–220,
 239, 285, 315, 327, 332
 solid electrolyte interphase (SEI) 151,
 196
 solid polymer electrolytes (SPEs) 4, 6
 advantages 113
 conventional batteries and transient
 batteries 120–123
 disadvantages 113
 dry 138
 DSSC 127
 ECW 370
 electrochemical sensor 128
 electrochromic devices 125–127
 electrodes and dry-state 191
 fuel cells 123

solid polymer electrolytes (SPEs)

(contd.)

- future aspect 196
- ionic conduction of 114
- ionic conductivity 192
- ionic liquids (ILs) 116, 117
- LIBs 189
- light 128
- lithium-doped 114
- lithium-ion batteries 208
- low lithium ionic conductivity of 190
- natural polymers 115
- PEO 114
- poly(ethylene oxide) (PEO) 189
- salt/polymer complexes 113
- sol-gel method 117
- solvent casting method 117
- supercapacitors 124, 242
- total ionic conductivity 117
- solid-state lighting devices 128
- solid-state supercapacitors 231, 259, 278, 284–285
- solvent casting method 117
- spin coating technique 349
- stationary backup power 100
- Stern layer 153, 234
- Stern model 233, 234
- Stokes-Einstein equation 207
- succinonitrile (SN) 9, 143, 248–250, 327–328, 333, 378
- sulfide electrolytes 17, 315
- sulfonated poly(ether ether ketone) (SPEEK) membranes 73–75, 79, 81, 90
- sulfonated polyvinylidene fluoride (SPVDF) 124
- supercapacitors 100, 124
 - asymmetric 279, 281
 - charge storage mechanisms in EDLCs 233–236
 - pseudocapacitors 236–238
- composite-type supercapacitors 280, 284
- electrochemical characterization
 - charge-discharge method 260–262

cyclic voltammetry 259–260

EIS 258–259

electrodes characterization of 255–258

electrolyte

characteristics 239

liquid 239–241

polymer 241–255

factors 232

hybrid 281–284

maximum power of 232

parameters 232

pseudocapacitors 270–272

solid-state 284–285

t

thermal analysis

DMA 87–91

DSC 75–82

TGA 67–75

thermal evaporation technique

352–353

thermo gravimetric analysis (TGA)

chitin-added nanocomposite

electrolytes 70

final temperature 68

isobaric mass-change determination 68

lithium-doped SPEEK membranes

75

Nanocellulose-laden composite PEs

74

PEO+LiTFSI 74

PEO, MgAl₂O₄ and lithium salt 72

polymer, chitin and lithium salt

compositions 70

procedural decomposition

temperature 68

PVDF-LiClO₄ PEO system 69, 70

reaction interval 68

types of 67–68

thiolate/disulfide redox couple

327–328

third generation solar cells 99, 302, 320

total ionic conductivity 117, 119

transient battery 120–123

- transition metal oxides (TMOs) 164,
270, 271, 274, 366, 367
- transparent conducting electrodes
(TCE) 164
- transparent conducting oxide (TCO)
126, 163–165, 314
- 2,4,6-trinitrotoluene (TNT) 128
- tungsten trioxide (WO_3) 164, 367, 373
- U**
- underpotential deposition 236–238,
271
- US Energy Information Administration
(EIA) 173
- V**
- vanadium oxide (V_2O_5) 122, 165, 205,
277–279
- vapor deposition method 352
- vinyl benzyl viologen (VBV) 379
- Vogel-Fulcher-Tammann (VFT)
equation 118, 374
- Vogel-Tamman-Fulcher (VTF) equation
206, 255
- voltaic cell 94, 95
- voltammogram 166, 237, 259, 260,
266, 274, 277, 377, 381
- W**
- Warburg impedance 40–41
- Warburg line 154
- wet battery cell 94
- wet NiCd battery recycling process
110
- Williams-Landel-Ferry (WLF) 206

