Index

а

advanced characterization techniques in-situ TEM 47–48 neutron diffraction 48–50 synchrotron radiation 46, 47 theoretical simulations 50–52 aqueous liquid electrolytes alkaline solutions 82 neutral saline solutions 82, 83 seawater/acid mixed solutions 83, 84 arc plasma method 15, 42, 43, 61, 71, 72 Arrhenius equation 12, 62, 63 Avrami–Erofeev equation 62

b

ball milling 18–20, 26, 29–32, 35, 37, 38, 40, 41, 46, 61, 70–74, 76, 93, 99 boron-centered electrolytes 6, 84, 89, 90 Brinkman equation 55 burst effect 50

С

carbon additives 73 carbon-based materials 20, 24–26, 114–115 carbon material doping 105 carbonyl compounds 6, 127–129 chalcogenides 6, 118–120 Chevrel phase 6, 97–100, 110 complex hydrides metal amides 28–30 metal boronhydrides or alanates 30–33 conversion-type cathode materials chalcogenides 118–120 Mg–I₂ batteries 126–127 Mg–O₂ batteries 120–121 Mg–S batteries 122–126 Mg–Se batteries 126 Mg–Te batteries 126

е

electroless plating method 41–43 electron energy loss spectrum 47 Elovich equation 12 equal channel angular pressing (ECAP) 38, 40

g

gas pipeline and filter 52 gel polymerized electrolytes (GPEs) 6, 95 graphitizable carbon 114 Grignard-based electrolytes 84–85, 87

h

heat transfer equations 54–56 heat transfer media 52, 53, 57 heat transfer pipe 57, 58 hexadecyl trimethyl ammonium bromide 102 HMDS-based electrolytes 86, 91 hydriding chemical vapor deposition (HCVD) 15, 39–41 hydrogen absorption 4, 9–60

Magnesium-Based Energy Storage Materials and Systems, First Edition. Jianxin Zou, Yanna NuLi, Zhigang Hu, Xi Lin, and Qiuyu Zhang. © 2024 WILEY-VCH GmbH. Published 2024 by WILEY-VCH GmbH. hydrogenation-dehydrogenation process 4, 31, 35, 38, 47, 71, 137 hydrogen combustion synthesis (HCS) 35-37hydrogen desorption 4, 10, 15, 18, 21, 24, 26, 27, 31, 32, 34, 38, 42, 44, 45, 50, 53, 55, 56, 59, 137 hydrolysis process carbon additives 73 cation and anion effect 66–69 metal halides 69–71 metal hydrides 72–73 metal oxides 72–73 metal sulfides 72–73 modifying pH value 63–65

i

insertion-type cathode materials Chevrel phase 97–100 molybdenum oxide (MoO₃) 105–106 V_2O_5 -Mg²⁺ insertion 100–105 uranium oxide (α -U₃O₈) 106–107 in-situ TEM 47–48 isothermal hydrogenation 9, 22, 25

k

Kozeny's equation 56

l

Langmuir theory 12 layered oxide cathode 107–108 layered structure cathode materials layered oxide cathode 107–108 layered sulfides/selenide cathode 108–109 layered sulfides/selenide cathode 108–109 light metal hydrides 30 liquid electrolytes aqueous 81–84 organic 84–92

m

magnesium–aluminium chloride complex (MACC) 86–87, 121, 128 magnesium hydride 1, 3, 4, 47, 50, 52, 61, 62, 67, 74, 137 magnesium monocarborane salt 89 mass transfer equations 55-57 mechanical alloying 37-39 melting-based methods 35 melt-spinning 35, 46 metal amides 28-30 metal boronhydrides or alanates 30-33 metal halides 69-72, 81, 83 metal hydrides 2, 3, 10, 24, 28, 30, 58, 69.72 metal ion doping 105 metal oxides 28, 43, 69, 72, 73, 100, 105-107.117 metal skeleton 57, 58 metal sulfides 72, 73, 108, 115 methyl magnesium chloride 45 Mg-based alloys hydriding chemical vapor deposition 39-41 mechanical alloying 37-39 melting-based methods 35 severe plastic deformation (SPD) methods 37-39 Mg-based hydrogen storage tank (HST) applications 59, 60 gas pipeline and filter 52 heat transfer equations 54-55 heat transfer media 52 mass transfer equations 55-57 thermal enhancement methods 57-59 vessel shell 52 volume expansion space 53 Mg-based materials alloying 14–17 arc plasma method 43 ball milling method 41 catalyzing 18-20 complex hydrides 28-33 nano-structuring 21-28 synthesis 44-46 Mg batteries anodes 132-135

aqueous liquid electrolytes 81-84 organic liquid electrolytes 84–92 solid and quasi-solid state electrolytes 93-96 MgCl₂-AlCl₃ (MACC)-based electrolytes 86-87 Mg–I₂ batteries 6, 93, 126–127 MgI₂ catalysts 3 Mg-Li hybrid electrolyte 86 Mg/MgH₂ chemisorption 10 crystal structure 9 kinetic mechanisms 10–14 nucleation and growth 10 penetration and diffusion 10 physisorption 10 thermodynamic mechanisms 9.10 thermodynamic stability 10 Mg nanostructures alloying with active metals 74 alloying with metals with higher corrosion potential 75-77 alloying with Si 77 controllable hydrolysis systems 77-79 $Mg-O_2$ batteries 6, 120–121 Mg-S batteries 6, 86, 90, 91, 95, 122-126 Mg-Se batteries 6, 126 Mg-Te batteries 6, 126 Mg(TFSI)₂-based electrolytes 87-89 microwave-assisted synthesis 101 molybdenum oxide (MoO₃) insertion-type cathode materials 105-106 MT₂-type intercalation cathode materials 115-117

n

nanoconfinement 23, 25–28, 44 nano-sized catalysts 18 nano-structuring 4, 10, 21–28, 137, 138 NASICON structure cathode materials 111–113 Navier-Stokes equations 56 neutron diffraction 46, 48–50 nitrogen-based compounds 7, 130, 131

0

olivine structure cathode materials 110. 111 organic cathodes carbonyl compounds 127-129 nitrogen-based compounds 130-131 organosulfur compounds 129-130 organic liquid electrolytes boron-centered electrolytes 89–90 Grignard-based electrolytes 84-85 HMDS-based electrolytes 86 MgCl₂-AlCl₂ (MACC)-based electrolytes 86-87 Mg(TFSI)₂-based electrolytes 87-89 other organic electrolytes 91-92 organic magnesium borate-based (OMBB) electrolyte 90, 123 organosulfur compounds 7, 129-130

р

phase change material (PCM) 37, 58, 59 physical vapor deposition 43, 46 polyanthraquinone sulfides (PAQS) 7, 128 polyimides (PIs) 129 poly(*N*-anthraquinoyl pyrrole (PAQPy) 131 powder compaction 57, 58

q

r

rechargeable magnesium-ion batteries (RMBs) 2, 5–7, 99, 100, 107, 137, 138

S

severe plastic deformation (SPD) methods 37–39, 46 solid electrolyte interphase (SEI) layer 88, 125

164 Index

```
solid polymer electrolytes (SPEs) 6, 93
solid state electrolytes 93–95, 111, 112
solid-state carbothermal method 111
spinel oxide cathode 109–110
spinel structure cathode materials
spinel oxide cathode 109–110
spinel sulfide cathode 110
spinel sulfide cathode 110
synchrotron radiation 46, 47, 50, 101
```

t

thermal enhancement methods	
heat transfer pipe 58	
metal skeleton 58	
thermochemical material 59	
thermochemical material (TCM)	59

u

uranium oxide (U_3O_8) 6, 106–107

V

 $V_2O_5-Mg^{2+}$ layer spacing effect 102–105 morphology effect 101–102 van't Hoff equation 4, 9, 10, 27 vessel shell 52 volume expansion space 52, 53

W

weak coordination anion (WCA) 89

X

X-ray diffraction (XRD) 28, 47