

Index

a

ABAQUS finite element analysis 256
 Accelerated corrosion tests 106
 acetone 35
 activation energy 41, 196
 active mode smart structure 145
 adaptability 144
 adduct 11
 adhesive reservoirs 144
 agglomeration 19
 aggregate 75
 aggregation 19
 alkali-silica solution 149
 alkaliphilic endospore-forming bacteria
 167
 alumina 194
 aluminum alloys 110
 aluminum oxyhydroxide 125
 amorphous 80
 amplitude of the elastic field 184
 anion-exchange pigment 126
 anodic oxidation 111
 anodization process 102
 anticipated costs 143
 anticorrosive pigment 102
 association constant 14
 Auger spectra 237
 austenite phase 21
 austenitic stainless steel 222
 autogenic 144
 autonomic 1
autogenic healing 145
 autonomic healing of cementitious
 composites 147
 autonomic self-healing process 74
 autonomic-healing 1
 autonomous repairing 104

b

bacteria immobilization 166
 bacterial concrete 167
 ballistic impact 81
 ballistic method 93
 ballistic puncture 73, 80
 ballistic self-healing 80
 ballistic self-repair 81
 barrier properties 108
 based metal-ligand complexes 16
 Bentonite clays 126
 bi-pyridine complexes 16
 bioinspired self-repairing materials 103
 biomimicry 144
 blistering 119
 BN Precipitation 234–238
 boehmite 108
 Boron (B) segregation 221
 Boron addition 228
 boron nitride (BN) precipitation 221
 Brinson one-dimensional SMA model 256
 brittle fracture 183
 bullet 81

c

calcium carbonate 167
 capillary effect 32
 capillary force 2
 capsules loaded with corrosion inhibitors
 106
 carbenes 20
 carbon nanotubes 21, 22
 carboxylates 12
 catalyst content 55
 catalysts containing microcapsules 3
 cathodic protection system 107

- cation-exchange pigment 126
- cation-exchange solids* 126
- cement 141
- cementitious materials 145
- ceramic nanocomposites 186
- Ceramics containing SiC whiskers 192
- cerate coating* 115
- Cerium-containing treatments 115
- ceriumoxysulfide 228
- chain scission 30
- chalk 146
- Chemical conversion coatings 113
- chemical degradation 143
- chemical inhibiting species 112
- chemical resistance 10
- chloranil 121
- chromate-based coatings 102
- Chromate-based pigments 103
- cinnamate monomer 11
- CO₂ emissions 143
- colloidal particle aggregation 17
- colloidal particles 19
- composite laminates 49
- composite metallic coatings 22
- composition-gradient films 122
- Comprehensive life cycle analyses 143
- Compression after impact 58
- compressive failure 65
- compressive strength 60, 147
- compressive stress 155, 224
- concrete* 141
- concrete-immobilized bacteria 168
- condensation polymerization 36
- conductive self-healing materials 20
- Conjugated polymers 110
- continuous damage and healing mechanics 267
- conversion coating 102
- copolymerization 12
- copper 110
- corroded defects 112
- corrosion 101
- corrosion inhibitors 22, 102, 112
- corrosion protection 101
- corrosive species 101
- counterion 75
- Cr-free conversion coatings 116
- crack geometry 184
- crack healing 2, 11, 29, 45, 152, 185
- crack healing of ceramics 186
- crack opening 153
- crack propagation 44
- crack repair 144
- crack-healed strength 190
- crack-healed zone 197
- crack-healing efficiency 272
- crack-healing temperature 195
- craze healing 30
- creep cavitation resistance 228
- creep cavities 221
- creep cavity 219
- creep cavity growth mechanism 226
- creep cavity growth rate 227
- Creep fracture 220, 221–223, 261
- creep resistance 258
- creep rupture strength 227, 228, 235
- Cross-linking 9
- crystallization 84
- curing kinetics 41
- current density 19
- cyanoacrylate 32
- cyclodextrin 123
- d**
- Damage 278
- damage evolution 268
- damage modes 81
- damage tensor 268
- damage variable 268
- damage hardening* 273
- damage-healing model 280
- debonding 11
- defected site 19
- defects 19, 101, 109
- deformation damage 242
- deformation-controlled tensile splitting test 164
- degree of damage 147
- degree of polymerization 15
- delamination 52, 119
- delamination resistance 53
- depolymerization 21
- Desmodur 23
- Desmophen 23
- deterioration 30
- dibutyltin dilaurate 3
- dicyclopentadiene 3, 33
- Diels–Alder (DA) reactions 10
- Diels–Alder reaction 32
- diethylene triamine 16
- diffusion coefficient 147
- diffusion rate 227
- diffusivity paths 257
- discrete cracks 177
- dislocations 242
- distributed damage 267
- double cantilever beam (DCB) tests 51
- ductility 221

- durability 101, 142
 dye-filled tubes 151
 dynamic strength 203
- e**
- efficacy of autogenic healing 147
 elastic closure 95
 elastic energy 84
 elastic healing 93
 elastic response 24
 elastic stiffness 269
 Electroactive conductive polymer 110
 electrochemical activity 112
 electrodeposition 19
 electrohydrodynamics 19
 Electrolytic co-deposition 22
 electromagnetic wires 19
 electronic doping 110
 electrostatic interactions 12
 elongation at break 43
 embedded catalyst 104
 embedded flaws 195
 embedded microcapsules 43
 embedded SMA wires 253
 emulsion 109
 encapsulation 32
 endospores 165
 engineered cementitious composites 147
 environmental-friendly pretreatments 118
 environmentally friendly self-healing anticorrosion coatings 103
 Epoxy healing agent 35
 epoxy resins 10
 epoxy resins, cyanoacrylates 148
 Epoxy-amine microcapsules 108
 epoxy-loaded microcapsules 51
 expansive agents 147
 extension of crack 54
 extremophilic bacteria 165
- f**
- fatigue cavity 219
 fatigue damage 241
 fatigue strength 202, 259
 Fatigue tests 246
 fiber-reinforced polymers 8
 figurations 184
 Finite element analysis 280
 flaws 184
 flexural mode 151
 flexural strength 12, 32
 flexural stress 156
 Fractography 246
- fracture energy 148
 Fracture Manner of Ceramics 183–185
 Fracture mechanism 221
 fracture strength 9
 fracture stress 208
 fracture toughness 3, 30, 43, 184, 267
 fractured surface 52
 free volume defects 242
 free-energy potential 268
 functional coatings 101
 functional layers 102
 functional materials 16
 furan 10
 furanic polymers 10
- g**
- Galvanic reduction 122
 galvanized steel 125
 gel formation 11
 gelatin microcapsules 150
 Glass Capillary Tubes 150
 glass supply pipes 151
 glass transition temperature 30
 glassy polymers 30
 grain boundary 221
 grain boundary diffusion rate 227
 Grubbs' catalyst 3, 33
- h**
- halloysite nanotubes 133
 healed crack 153
healing 80
 healing agents 3, 32, 104, 148
 healing efficiency 19, 48, 277
 Healing Hardening 279, 280
 Healing Model 272–274
 healing modeling 277
 healing of cementitious materials 147
 healing response 88
 healing tensor 272
 heat resisting steels 220
 heat treatment 185
 hectorite 108
 hexavalent chromium compounds 102
 high-density polyethylene 90
 hollow fibers 2
 hollow glass fiber 32
 hollow glass fibers (Hollex fibers) 5
 hollow spheres 104
 Hydraulic calcium aluminates 108
 Hydrogen bonding 14
 hydrogen peroxide 115
 hydrostatic pressure 224
 hydrotalcite 127

i

imidazole 39
impact damage 58
impact energy 60, 65
impregnation 51
impression depth 90
Influence of Crack Width 159
Influence of Relative Humidity 159
inhibition primer 102
intelligent materials 29, 144
inter/intramolecular attractions 78
interdiffusion 84, 87
interfacial adhesion 55
interfacial healing 80
interfacial interaction 43
interfacial knitting process 91
interfacial polymerization 108
interfacial strength 252
interfacial welding 80
interlaminar fracture toughness 58
inverse 108
ion pairs 75
ion-containing polymers 74
ionic aggregation 75
ionic clusters 76, 77
ionic content 75
ionic groups 75
ionic interactions 12, 75
ionic multiplet 76
ionizable inhibitors 120
Ionomers 12, 73, 79
– self-healing 79
iron 110

k

Kaiser effect 147

l

latent curing agent 43
latent hardener 35, 46
lattice beam modeling method 177
lattice spring model 22
layer-by-layer (LbL) assembled shells 129
ligands 17
liquid healing agent 3
liquid-assisted healing 252
long-term relaxations 84
longevity 143
low alloy steels 221
low-density polyethylene 80

m

Machining process 204
macrocracks 267

macromolecular materials 14
Magnesium sulfate 109
magnetic nanoparticles 96
maintenance cost 143
maleimide 10
martensite phase 21
mechanical stress 24
mechanism of self-healing 74
mercaptobenzimidazole 120
mercaptobenzothiazole 120
metal cations 12
Metal complexes 16
metal–ligand interactions 14
metallic alloy 115
Metallic materials 219
metallic structures 101
methylol urea 36
microcapsules 2, 3, 33, 38, 106
microcracking 29
microcracks 20, 141
microencapsulated healing agent 104
microencapsulation 3, 36
microstructure 77
microvascular network 8
mild steel 110
mineral precipitation 167
modified beam theory 53
modulus 43
Molybdates 113
montemorillonite 126
mortar 141
multiple healing 4
multiplets 75
multiwalled nanotubes 21

n

n-benzotriazole 117
nanocapsules 22
nanocontainers 122
nanoparticles 22
nanoporous reservoir 117
nanosol 124
neutralization process 75
Nitinol 21
nonautonomic 2
nonautonomic healing phenomenon 9
nonballistic methods 92
noncovalent interactions 14
nonionic copolymers 79
nonionizable inhibitors 120
nonlinear damaging behavior 274
nucleation 225
nucleation of precipitates 257
numerical material model 168

- o**
- oil-in-water (O/W) emulsion 35
 - order-disorder transition 78
 - organic coatings 101
 - Organic inhibitors 120
 - organometallic polymers 20
 - organosilane coating 125
 - organosiloxane-based films 120
 - oxide ceramics 198
 - oxide nanoparticles* 123
- p**
- passivation 102, 111
 - “passive” host-“active” guest structures 122
 - passive mode smart structure 145
 - percolation pathways 20
 - percolation threshold 21
 - permanganates 113
 - permeability 147
 - phase separation 104
 - phosphate conversion coatings 116
 - phosphonic acid dopants 112
 - photochemical cycloaddition 11
 - physical cross-links 13, 75
 - Pipe diffusion 242
 - plastic deformation 21
 - Plastic strains 271, 275
 - plasticizer 97
 - poly(ethylene imine) 129
 - poly(ethylene-co-methacrylic acid) (EMAA) 73
 - poly(methyl methacrylate) 29
 - poly(phenylene vinylenes) 110
 - poly(phenylenesulfide) 108
 - poly(styrene sulfonate) 129
 - polyamides 11
 - polyaniline 110
 - polybutadiene 30
 - polycarbonate 30
 - polycondensation 3
 - polycondensation 36, 104
 - polycrystalline ceramics 185
 - polycyclopentadiene 3
 - polydiethoxysilane 3
 - polydimethylsiloxane 3
 - polyelectrolyte containers 129
 - polyheterocycles 110
 - polymeric self-sealing coating 108
 - polymerizable healing agent 56
 - polyphenylene-ether 31
 - polypyrrole 110
 - polysiloxanes 16
 - polythiophene 110
 - polyurethane microcapsules 3, 33
 - polyvinyl acetate 32
 - porosity 51
 - porous fillers 126
 - “pot life” 149
 - Precipitation of BN 234
 - precipitation-induced densification mechanism 260
 - pretreatment 102
 - projectiles 81
 - propagation of cracks 2
 - protective coatings 101
 - pseudoplasticity 50
 - puncture 84
 - puncture damage 81
 - pyrolysis 37
- q**
- quadruple hydrogen bonding 14
- r**
- Rare earth compounds* 115
 - rate constant 42
 - Re-sintering 185
 - recombination 30
 - redox-active materials 111
 - refabrication ability 9
 - reflow of materials 23
 - reflow-healing of defects 105
 - rehealing 30
 - reinforced concrete 141
 - reinforcing fibers 19
 - relaxation process 78
 - release of the active agent 106
 - release of the healing agent 149
 - remendable polymers 10
 - repair costs 143
 - repairing agent 150
 - repeated damage events 104
 - reservoirs 2, 112
 - residual stress 23
 - restricted mobility region* 75
 - reversible cross-links 9
 - reversible hydrogen bonding 89
 - reversible reactions 10
 - rigidity 50
 - ring-opening-metathesis polymerization 3, 33
- s**
- sacrificial anode 19
 - sacrificial cathodic protection 121
 - satellite indentation technique 195
 - scaffold 8

- “Scratch Guard Coat” 23
 - segregation 226
 - Self-crack healing 187
 - self-doped* 110
 - “self-diagnosis composite” sensor 148
 - self-healing 1, 34, 42, 74, 80
 - behavior 80
 - composites 42
 - epoxy composites 34
 - ionomers 74
 - self-healing ability 101
 - self-healing alloy composite 253
 - self-healing anticorrosive coatings 22
 - self-healing behavior 74
 - self-healing capacity of concrete 168
 - self-healing composites 95
 - self-healing conversion coating 114
 - self-healing corrosion protection systems 102
 - self-healing efficiency 22
 - self-healing epoxy composites 104
 - self-healing for structural ceramics 187
 - self-healing hybrid films 120
 - Self-healing in Aluminum Alloys 258–261
 - self-healing mechanisms 23, 165
 - self-healing metals 252
 - self-healing of cementitious materials 168
 - self-healing of concrete 148
 - self-healing of creep cavity 219
 - self-healing of fatigue crack 241
 - self-healing of surface cracks 183
 - self-healing polymer coatings 24
 - self-healing polymer composites 3
 - self-healing processes 2
 - self-healing response 81
 - self-healing rubbers 16
 - self-healing strategy 3
 - self-mending 16, 32
 - self-repair ceramic composite protective coating 108
 - self-repair of damage 73
 - self-repairing 1, 31
 - self-sealing coating 108
 - self-validating adhesives 104
 - semicrystalline polymers 80
 - Sensory structures 146
 - shape memory alloys 21, 252
 - shape memory effect 21
 - Shear tests 276
 - shooting 80
 - SiC multicomposite* 212
 - Silica nanoparticles 129
 - silicon carbide 187
 - silicon nitride 194
 - simulation of crack healing 159
 - sintering 223
 - “smart” corrosion protection 112
 - Smart materials 145
 - Smart structures 145
 - sol–gel coating 117
 - solid-state healable system 33
 - solid-state healing 252
 - solute atom 242
 - solute elements 220
 - solvent resistance 9
 - spherically shaped capsule 149
 - splitting tests 150
 - stainless steel 110
 - static stress 198
 - steel reinforcement 174
 - steel substrate 109
 - steric effects 75
 - stiffness 162, 276
 - strength recovery 158, 195
 - stress concentration 183
 - stress corrosion cracking 202
 - stress intensity factor 184
 - stress-contour plot 161
 - structural ceramics 183
 - sulfonates 12
 - superglues 149
 - supramolecular assemblies 15
 - supramolecular polymers 14
 - surface cracks 183
 - surface diffusion of creep cavity 227
 - surface tension 23, 85
 - Surlyn 80
 - swelling 108
- t**
- telechelic 15
 - tensile mode 151
 - tensile strength 30, 43
 - terpyridine 16
 - The refractoriness 197
 - thermal stress* 184
 - thermally reversible polymers 10
 - thermomechanical properties 78
 - thermoplastic materials 80
 - thermoplastic polymers 23, 29
 - thermoplastic polyurethane elastomer 91
 - thermoreversibility 11
 - thermosetting polymers 23, 29
 - three-point bending test 152
 - threshold stress 199, 275
 - titanium 110
 - tolyltriazole 120
 - toughening efficiency 44

trace elements 227
tubular capsule 149
tungstates 113

u

ultrasonic images 61
unhydrated cement 161
unrecoverable (plastic) strain 275
urea-formaldehyde resin 33, 36
urea-formaldehyde microcapsules 150
ureidopyrimidone 14

v

vacancies 242
vanadates 113
vesicles 105
vinyl ester 104
viscous flow 23

voids 19
voids and pores 184
volume fraction 190

w

Weibull approach 201
Woven glass fiber-reinforced polymer
composites 49

y

yield strength 21, 275
Young's modulus 43

z

Zeolite particles 126
zinc 110
zinc stearate 97
zirconia nanoparticles 124