

Index

a

- acrylic-SAP 131
- activated carboxylic acids 2
- adhesive mixtures in paper
 - conservation
 - GPC analysis of 180–182
 - preparation of 177, 178
- Aerocellulose 380, 381
 - density 378
 - shapes 378
 - thermal conductivity 378, 379
- aerogels 296–297
 - alginate 386
 - applications 315–317, 373
 - cellulose I based 373–378
 - cellulose II based 378–380
 - conductive 305–307
 - density and specific surface areas 372
 - description 371
 - drying of solvogels 297–301
 - hydrophobic aerogels and superabsorbents 307–315
 - mechanical properties 301–305
 - pectin-based 380–386
 - starch-based 386
- aeropectins
 - mechanical properties 381, 382
 - morphology 381, 382
 - thermal conductivity vs. density 382, 383
- aging *see also* paper preservation and restoration approach
 - brightness of paper before and after 185, 186
 - contact angle before and after 184, 185
- alginate aerogels 386
- alkyne-modified CMC 295
- ambient-dried aerogel membranes 306
- amino-/ammonium group containing cellulose esters
 - cellulose-4-(*N*-methylamino) butyrate 7–9
 - (3-carboxypropyl) trimethylammonium chloride esters 2–6
- amino cellulose carbamates
 - properties 22–23
 - synthesis 21–22
- ω -aminoethyl cellulose carbamate 23
- ω -aminoethyl-p-aminobenzyl cellulose carbamate 23
- amorphous cellulose 264
- anhydroglucose units (AGUs) 113, 115, 116, 118, 119, 227
- attenuation length 240
- azido-modified CMC 295

b

- bacterial cellulose (BC) 254
 - emulsions stabilized with 406–407
 - BC sheets 430–432
- ball milling 194
- Bemberg™ fiber 343
- bifunctional cellulose nanocrystals 401
- bio-aerogels 387, 388 *see also* aerogels
- Biocelsol process 343
- biocompatibility 128
- biodegradation 128
- bovine serum albumin (BSA) 2, 3
- 1,2,3,4-butanetetracarboxylic acid 307

c

- Cagliotti parameters 233
- carboxyethyl cellobiose
 - structure 136
 - radial distribution function on O6 137
 - contour density maps 138
- carboxyethyl cellulose (CEC) 128
 - biodegradability 129
 - bound and free water contents 131, 132
 - chemical modification and biodegradability 138–140
 - degree of polymerization 129
 - degree of substitution 129
 - DSC thermograms of water adsorbed on 131, 132
 - exo-type cellulose treatment of 129
 - molecular dynamics simulation 136–138
 - SAXS 133–135
 - super-absorbent polymer 130
- carboxylate-based ionic liquids (ILs) 346
- carboxymethylated cellulose
 - nanofibrils (cm-CNF) 282
 - carboxymethylation of 280
 - hydrogel formation 311
- carboxymethyl cellobiose
 - average structure 136
 - contour density maps for 138
 - radial distribution function on O6 137
- (3-carboxypropyl)trimethylammonium chloride esters of cellulose 2–6
- cationic ring opening polymerization (CROP) 102
- cellobiose
 - average structure 136
 - radial distribution function on O6 137
 - contour density maps for 138
- cellulose 1
 - aerogels 296–297 *see also* aerogels
 - allomorphs 101
- cellulose dissolution *see* cellulose swelling, dissolution and regeneration
- cellulose-dissolving ionic liquids (ILs) 345
- cellulose ethers, history 143, 144
- cellulose hydrogels 283
- cellulose I based aerogels 373–378
- cellulose II aerogels *see* Aerocellulose
- cellulose microfibrils (CMF) 235, 265
 - “amorphous” regions 264
 - 36 (6 x 6) chain model 263
 - crystallinity 263
 - fringed-fibrillar model 264–267
 - high aspect ratio 263
 - leveling-off degree of polymerization 267–269
 - longitudinal order of 263
 - preparation of cellulose nanocrystals 270–271
 - schematic representation of 264
 - small angle neutron scattering 264
- cellulose nanocrystals (CNCs) 193
 - from bacterial cellulose 224

- bifunctionalized 401
- binding capability of cationic surfactants 402–404
- chemical characterization
 - elemental analysis 238–239
 - infrared spectroscopy 237–238
 - proton NMR 244
 - pulsed-field-gradient spin-echo NMR 244
 - solid-state NMR spectroscopy 234–237
 - X-ray photoelectron spectroscopy 240–243
- chirality and 253–255
- CNC–CoFe₂O₄ hybrid nanoparticles 417
- degree of substitution 228
- degree of sustainability 394
- expressions of chirality 257–259
- flat ribbon 226
- high internal phase emulsions 397
- level-off degree of polymerization (LODP) 225
- model representation 227
- and molecular structure of cellulose 223–224
- morphological and structural characterization
 - microscopy 228–230
 - powder X-ray diffraction 230, 232–234
 - small angle scattering 230–231
- nematic/smectic-ordered materials 255–256
- periodate oxidation and reductive amination 400, 401
- preparation of 270–271
- protofibrils 223
- films without iridescent colors 256–257
- size 225–226
- small angle neutron scattering 396
- sulfuric/phosphoric acid hydrolysis 226, 395
- surface charge density 393
- surface wettability 404
- terminal complexes 223
- unit cell 224–225
- Valonia*, 224
- XPS scans on 243–244
- cellulose nanofibrils (CNFs)
 - aerogels 296–297
 - applications 315–317
 - conductive aerogels 305–307
 - drying of solvogels 297–301
 - hydrophobic aerogels and superabsorbents 307–315
 - mechanical properties 301–305
- AFM and TEM micrographs of 280–281
- alginate composite 291
- carboxymethylation 280
- CNF/PVA composite 304
- degree of crystallinity 279
- enzymatic pretreatment 280
- fibrillation 280
- formation of microfibril bundles 277–278
- high-intensity ultrasonication 280
- high-pressure homogenization 279
- hornification 281
- hydrogels
 - biocompatibility 286
 - biomedical application 283
 - composite 288–293
 - dark field microscopy micrograph 288
 - definition 282
 - from enzymatically pretreated pulp 286
 - fibrillar nanostructure 286
 - food applications 283
 - and hepatocellular carcinoma cells 284–285
 - mechanical properties 286

- cellulose nanofibrils (CNFs) (*contd.*)
 - modification 293–296
 - Pickering emulsions 288
 - preparation of 284–285
 - properties and high-value applications of 317–318
 - stimuli-responsive properties 283
 - tempo-oxidized gyroidal hydrogels 287
 - inter- and intra-chain hydrogen bonds 277
 - interfiber bondings 281
 - mechanical pretreatment 280
 - mechanical properties and viscosity of 282
 - nanocellulose 278
 - nitrocellulose 277
 - tensile strengths and elastic moduli 279
 - tempo-oxidized hydrogels 280, 287
 - cellulose nanofibrils (CNF)/polystyrene composite nanospheres 412
 - cellulose-4-(*N*-methylamino)butyrate (CMABC) 7–9
 - cellulose–silica composite aerogels 375, 379, 380
 - cellulose swelling, dissolution and regeneration
 - cellulose solvents 113–118
 - ¹³C-perlabeled cellulose model compounds 102–108
 - DMAc/LiCl solvent system 110, 112
 - effects on anhydroglucose unit 113, 115, 116, 118, 119
 - EMIm-OAc solvent 113, 114
 - H-bond cleavage 109
 - nonclassical CH-hydrogen bonds 117
 - swelling phases 109
 - cellulosic bottlebrushes
 - “grafting-from” approach 50
 - “grafting-to” approach 51
 - chiral nematic arrangement 253–254
 - 2-chloro-4,4,5,5-tetramethyl-1,3,2-dioxaphospholane 237
 - click reaction 61
 - CMF *see* cellulose microfibril (CMF)
 - CNCs *see* cellulose nanocrystals (CNCs)
 - composite hydrogels 307
 - conductive aerogels 305–307
 - conductive hydrogels 292
 - coniferyl alcohol (CA) 430
 - conventional freeze drying (CFD) 373, 374
 - ¹³C-perlabeled cellulose 103
 - ¹³C-perlabeled cellulose model compounds 102, 103
 - C,C-couplings 104
 - NMR experiments 104–107
 - NMR intensity gain 105–106
 - specific hydrogen bonds, detection of 107, 108
 - cross-linked hydrogel 317
 - crystallinity index 232
 - Cuoxam 341
- d**
- [DBNH]OAc preparation
 - chemical composition analysis 349
 - fiber spinning 350
 - mechanical analysis of fibers 351
 - molar mass distribution analysis 349–350
 - pulp dissolution and filtration 348–349
 - rheological measurements 349
 - stepwise purification 348
 - dehydrogenation polymer (DHP) 430–431
 - delignification/cellulose degradation
 - selectivity
 - in batch reactor 82
 - for Kraft pulp 86–90

- definition 81
 - HexA content 83
 - hydroxyl/oxyl radical generation 82
 - NaOH charge effect 79, 80
 - NaOH concentration 84, 85
 - number of cellulose chain scissions
 - per cellulose polymer 81
 - oxygen pressure effect 84, 85
 - pulp properties 84
 - temperature effect 84, 85
 - 6-deoxy-6-amino cellulose derivatives
 - 9–21
 - application potential 13–21
 - spontaneous self-assembling 10–13
 - 1,5-diazabicyclo[4.3.0]non-5-ene-1-ium acetate ([DBNH]OAc) 347
 - differential scanning calorimetry (DSC) 131–133
 - direct hydrophobization method 295
 - dissolution *see* cellulose swelling, dissolution and regeneration
 - double emulsions 409–412
 - drying of solvogels 297–301
 - dye-sensitized solar cells (DSSCs) 29, 30
 - dynamic light scattering (DLS) 228
- e**
- elasticity of cellulose 428
 - electron microscopy 228
 - elemental analysis 238–239
 - [EMIm]OAc 346
 - emulsions
 - double 409–412
 - emulsion-precursor systems with stimuli-responsive behavior 413–417
 - with polymer coemulsifiers 406–409
 - stabilized with modified nanocelluloses 398–402
 - surfactant-assisted 402–406
 - surfactant-free 395–397
 - enzymatically pretreated pulp 286
 - enzyme immobilization on amino cellulose 13, 14
- f**
- fiber spinning 350, 354–355
 - fibrillar-structured CNF cryogel 303
 - flat bacterial cellulose (FBC) 430–432
 - fluorescence/UV-Vis spectroscopy 243
 - Fortisan[®] 342
 - 4D biomimetic printing of CNF 291–292
 - free-standing hydrogels 373
 - free water 127
 - freeze-dried hydrogels 314
 - fringed-fibrillar model 264–267
 - fullerene-bound cellulose derivative 44–45
- g**
- gel permeation chromatography (GPC) *see* size exclusion chromatography (SEC)
 - gyroid CNF scaffold 287
- h**
- heptane-in-water Pickering emulsions 398
 - hexeneuronic acid content of pulp 76
 - highest decision coefficient 428
 - high-intensity ultrasonication 280
 - high internal phase emulsions (HIPEs) 397
 - high-kappa oxygen delignification 92–93
 - highly crystalline algal cellulose 254
 - highly transparent aerogels 303
 - honeycomb deformation 425–426

- honeycomb-patterned bacterial cellulose (HPBC)
 - breath-figure method 424
 - cellulose I and II polymorphisms 423–424
 - cellulose II polymorphism and tensile strength 426–428
 - deposition of wood cell wall components 430–432
 - schematic diagram 423–424
 - validity of deformation models 428–430
 - honeycomb-patterned regenerated cellulose (HPRC) 424
 - hornification 281
 - HPBC *see* honeycomb-patterned bacterial cellulose (HPBC)
 - hydrogels
 - biocompatibility 286
 - biomedical application 283
 - composite 288–293
 - dark field microscopy micrograph 288
 - definition 282
 - enzymatically pretreated pulp 286
 - fibrillar nanostructure 286
 - food applications 283
 - and hepatocellular carcinoma cells 284–285
 - mechanical properties 286
 - modification 293–296
 - Pickering emulsions 288
 - preparation of 284–285
 - properties and high-value applications of 317–318
 - protonation 287
 - stimuli-responsive properties 283
 - tempo-oxidized gyroidal hydrogels 287
 - hydrogen bond network in cellulose 100, 101
 - hydrophilic polymer 307
 - hydrophobic aerogels 307–315
 - hydrophobized bacterial cellulose nanocrystals 401–402
 - hydroxyalkylmethyl celluloses 153–159
 - hydroxyethylmethyl celluloses (HEMCs) 159–161
 - hydroxypropylmethyl celluloses (HPMCs) 160, 162–166
 - MALDI-ToF-MS 160, 162
 - methyl subpattern 162–164
- i**
- imidazolium-based ionic liquids (ILs) 345
 - infrared spectroscopy 237–238
 - inorganic aerogels 296
 - in situ surfactant-assisted adsorption approach 402
 - intermediate water 127
 - ionic liquids (ILs) 344–345
- j**
- jamming process 254
 - Janus-type cellulosic bottlebrush 49, 50
 - regioselective formation 51, 52
 - size-exclusion chromatography 61–63
- l**
- Langmuir–Blodgett (LB) film
 - photosensitizer-bound cellulose derivatives 30, 31
 - phthalocyanine-bound cellulose derivatives 36, 39
 - squaraine-bound cellulose derivative 42
 - leveling-off degree of polymerization (LODP) 225, 267–269
 - light silica aerogels 296
 - liquid chromatography under critical conditions (LCCC) 149
 - living radical polymerization (LRP) 49

low-density silica aerogels 296
 Lyocell process 343
 Lyocell-type fibers 344

m

magnetic hydrogels 292
 magneto-responsive CNC materials 417
 man-made cellulosic fibers (MMCFs)
 Bemberg[™] fiber 343
 Bocel/Fibre B 344
 carbamate process 342
 with carboxylate-based ILs 346
 direct solvents 341
 direct solvent systems 344
 fiber analysis
 chemical composition 349
 spinnability 350
 mechanical analysis 351
 molar mass distribution 349–350
 pulp dissolution and filtration 348–349
 rheological measurements 349
 stepwise purification 348
 fiber properties 355–360
 fiber spinning 354–355
 Fortisan[®] 342
 with halide-containing ILs 346
 influence of noncellulosic constituents 360–361
 intermediate cellulose derivatives 342
 with ionic liquids 344–346
 Lyocell process 343
 Lyocell-type fibers 344
 nitrocellulose 341
 from NMMO monohydrate 343
 polyacrylonitrile 345
 rheological properties 352–354
 from solution in superbase-based ILs 347
 steam pretreatment 343

Tencel[®] 344
 for textile applications 343
 viscose production 342
 manmade hydrogels 283
 medium internal phase emulsion (MIPE) 397
 mesoporous hydrogels 300
 methyl cellulose (MC)
 average degree of substitution 146–149
 distribution along and over polymer chains 149–153
 fractionation 152
 methylation pattern 146–149
 regioselectivity influence on methylation patterns 148
 methyl 4'-*O*-methyl- β -D-cellobioside-¹³C₁₂
 in NMMO solvent 110, 111
 swelling phases of 109
 microcontact printing (μ CP) 16, 17
 microscopy 228–230
 MMCFs *see* man-made cellulosic fibers (MMCFs)
 modified nanocelluloses, emulsions stabilized with 398–402
 modulus of elasticity 428–429
 molar mass analysis, of paper samples 182–184
 molecular bottlebrush 49, 50
 multi-angle light scattering (MALLS) 228
 multihollow magnetic imprinted microspheres (HM-IMs) 412
 multistructured polystyrene beads 412

n
 nanocellulose 253, 278
 nanofibrillated cellulose (NFC) *see* cellulose nanofibrils (CNFs)
 nanozeolite (NZ) 377, 378
 native cellulose 264
 nematic-ordered cellulose 255

- nematic/smectic-ordered materials
255–256
- nitrocellulose 341
- N*-methylmorpholine *N*-oxide
monohydrate (NMMO)
107–108, 343
- “No-D” (no deuterium) NMR
technique 209
- nonfreezing water 127
- nonmodified single-walled carbon
nanotubes (SWCNT) 305
- O**
- 6-*O*-bromoisobutyryl-2,3-di-*O*-
methylcellulose synthesis
52–53
- oil–water interfacial stabilization, by
CNC *see* cellulose nanocrystals
(CNCs)
- one-dimensional (1D) solution-state
NMR spectroscopy *see*
solution-state NMR
spectroscopy
- 6-*O*-*p*-methoxytritylcellulose
poly(ethylene oxide) introduction at
O-2,3 position 57–58
poly(styrene) introduction at *O*-2,3
position 55–57
- organic electrolyte solutions 194
- organo-soluble amino cellulose
derivatives 20
- organo-soluble
6-deoxy-6-(ω -aminoalkyl)
amino cellulose carbamates 18
- oxygen delignification Berty CSTR
experiments 83, 84, 90
- oxygen delignification of softwood
Kraft pulp 67
advantages 68
carbohydrate loss during 91
delignification/cellulose degradation
selectivity
in batch reactor 82
for commercial Kraft pulp 86–90
HexA content 83
hydroxyl/oxyl radicals generation
82
NaOH charge effect 79, 80
NaOH concentration 84, 85
number of cellulose chain
scissions per cellulose polymer
81
oxygen pressure effect 84, 85
pulp properties 84
temperature effect 84, 85
disadvantage 68
extending the range of 69–70
improving pulp yield 90–92
initial reaction 70, 71
mass transfer resistance 69
orthoquinone and muconic acid
structure formation 71
reactivity of residual lignin 73–79
stepwise reduction of oxygen to
water 71, 72
two-stage conditions 70
- P**
- palladium (II) phthalocyanine-bound
cellulose derivatives 40
- paper-based heritage materials 175
- paper brightness 185–186
- paper destruction, exogenic factors of
175
- paper preservation and restoration
approach 175
accelerated heat-induced aging 179
adhesive mixtures and films 177,
178
adhesives/surface consolidants 176
paper sample preparation 177–179
contact angle measurements 180,
184–185
GPC analysis 179–182
paper brightness analysis 180,
185–186

- pectin aerogels 387
- pectin-based aerogels 380–386
- pectin–silica aerogels
- mechanical properties 385
 - morphology of 383, 384
 - thermal conductivity 385
- perdeuterated cellulose solvents 103, 104
- phosphorus (^{31}P) NMR 214, 237
- autohydrolyzed birch samples, solubility of 218, 219
 - ionic liquid-based media 212
 - phosphitylated MCC 215, 216
 - wood solubility in ionic liquids 215, 216
- photosensitizer-bound cellulose
- derivatives 29, 31
 - Langmuir–Blodgett film of 30, 31
 - photocurrent generation from 46
- phthalocyanine-bound cellulose
- derivatives 34
 - chemical structure 36
 - LB monolayer film 36, 39
 - palladium (II) containing 40
- polyacrylonitrile (PAN) 345
- polyelectrolyte complexes (PECs) 3
- polyethyleneimine-grafted CNF aerogels 317
- polymer analog reaction 149
- polymer coemulsifiers 406–409
- poly(*N*-isopropylacrylamide) grafted CNC 398, 399
- porphyrin-bound cellulose derivatives 31–34
- porphyrin-bound chitosan derivative 45
- powder X-ray diffraction 230, 232–234
- protofibrils 223
- pulsed-field-gradient spin-echo (PFGSE) NMR 244
- pure form factor 230
- PVA/CNF nanocomposites 289–290
- r**
- rag paper samples
- molar mass changes 183
 - water contact angles 184
- regenerated cellulose fibers 99
- regeneration *see* cellulose swelling, dissolution and regeneration
- regioselective grafting 51
- of cellulose 52–54
 - of polyNIPAM 53
- Rietveld refinement 233
- rosette terminal complexes 277
- ruthenium(II) complex-bound cellulose derivative 42–44
- s**
- sampling depth 240
- scanning electron microscopy (SEM) 228
- scattered intensity 230
- self-assembled monolayers (SAM), of amino celluloses 12
- self-assembling of 6-deoxy-6-amino cellulose derivatives 10–13
- self-healing nanocomposite 289
- silica aerogels 296
- cellulose nanofibril reinforcement 375
 - drawbacks 296
 - improving mechanical properties 372
- siloxane CNF composite 310
- size exclusion chromatography (SEC)
- of Janus-type bottlebrush 61–63
 - of paper samples 179–182
- small-angle X-ray scattering (SAXS) 133–135, 230–231
- smart hydrogels 283
- softwood Kraft pulp *see* oxygen delignification of softwood Kraft pulp
- solid state NMR spectroscopy 234–237

- solution state NMR spectroscopy
 application in biofuels and
 biorefineries 193
 comparison with solid-state ^{13}C
 CP-MAS NMR 191
 of cellulose and pulp 203–211
 of lignocellulosics 191, 192
 of modified nanocrystalline cellulose
 211–212
 ((poly) methylmethacrylate)-grafted
 cellulose nanocrystals 211,
 212
 solvents used 191, 192
 solvent-suppression technique
 209
 wheat bran extracts 210, 211
 whole lignocellulosic biomass 198
 anomeric region of 2D HSQC
 spectrum 197
 DMSO- d_6 /HMPA- d_{18} solvent
 system 202
 DMSO “gel-state” method 195
 HSQC spectra, pretreatment
 methods 199–201
 HSQC spectrum of pulps
 205–207
 ionic liquid-based organic
 electrolyte solutions 199
 NMI- d_6 /DMSO- d_6 solvent system
 195, 196
 perdeuterated pyridinium chloride
 electrolyte solution 197, 199
 solvogels, drying of 297–301
 spray freeze drying (SFD) 373, 374
 Spurlin model 145
 squaraine-bound cellulose derivative
 42
 stable CNF hydrogels 288
 starch-based aerogels 386
 Steglich esterification 37
 styrene-based Pickering emulsions
 395, 396
 superabsorbents 130, 307–315
 superamphiphobic CNF aerogel
 312–313
 superbase-based IL
 1,5-diazabicyclo[4.3.0]non-5-
 ene-1-ium acetate
 ([DBNH]OAc) 347
 superhydrophobic aerogel 311
 surface grafting 412
 surfactant-assisted emulsions
 402–406
 surfactant compatibilization
 mechanism 412
 surfactant-free emulsions 395–397
 surfactant-free O/W/O double
 emulsions 409, 410
 swelling *see* cellulose swelling,
 dissolution and regeneration
 synthetic strategies, of
 phthalocyanine-bound cellulose
 derivatives 35, 38
- t**
 tannic acid (TA) 407
 TEMPO-CNF-stabilized foams
 405–406
 TEMPO-oxidized cellulose nanofibrils
 (TO-CNF)
 aerogels 296
 and graphene oxide nanosheets
 293
 gyroidal hydrogels 287
 hydrogels 280, 287
 Tencel[®] 344
 2,2,6,6-tetramethylpiperidine-1-oxyl
 (TEMPO)-mediated oxidation
 266
 2,2,6,6-tetramethylpiperidine-1-oxyl
 (TEMPO)-oxidized wood
 254
 thermal conductivity
 acid-gelled pectin aerogels
 387
 calcium-gelled pectin aerogels 387

- cellulose–silica composite aerogels 379
 - vs. density, aropectins 382, 383
 - nanocellulose aerogels 373, 374
 - of pectin–silica aerogels 385
 - thermoreversible gelation 145
 - transmission electron microscopy (TEM) 228–229
 - tritylcellulose aerogel 380
 - two-dimensional (2D) solution-state NMR spectroscopy *see* solution-state NMR spectroscopy
 - two-phase annual ring model 426
 - two-stage oxygen delignification conditions 70
- u**
- Ultra-Turrax[®] disperser 282
 - UV–Vis measurements, of paper brightness 185–186
- v**
- viscose fibers 342
- w**
- water absorbency of SAP 130
 - water-dispersible rare-earth upconversion nanoparticles 405
 - Whatman paper samples
 - molar mass changes 183
 - water contact angles 184
 - wheat bran extracts 210, 211
- x**
- X-ray photoelectron spectroscopy (XPS) 240–243
- y**
- Young modulus of acid-gelled aropectins 381, 382
- z**
- Zeisel method 146

