

Index

- absorption 14, 100–3, 140, 169–70, 242–43, 266, 350–51, 359–60, 366, 460, 571–72, 637, 705–6, 709–10, 717
electronic 57, 113, 115, 126, 128–30, 634, 708, 714, 716
mixed porphyrin films 558
absorption bands 26, 167, 186–87, 189, 196, 207, 235, 242, 245, 291, 298, 357, 707, 721–22, 738–39
electronic 52, 86, 706, 761
transient 397, 418, 423, 519
absorption spectra 4, 27, 30–31, 60–61, 70, 162, 185, 242, 248, 305, 337, 361–62, 374, 706–7, 744–45
differential 686, 688, 690
electronic 96, 141, 151, 160
acceptor layers 538, 547, 555–57, 574–75, 577–79, 654
acceptor moieties 201, 500–1, 508–9, 559, 562
acceptor molecules 437, 442, 555, 557–58, 591, 593–94
acceptors 58–59, 71, 82, 233, 237, 266, 349–50, 441–42, 508–9, 537–40, 555–59, 564, 574–76, 578–79, 592–97
secondary 574, 576
acetonitrile 254, 408, 448, 468, 470, 473, 475–77, 479–80, 482, 507, 509, 515–16, 518
acetonitrile/toluene 458, 470, 473, 475, 478, 507–8, 513, 526
action spectra, photo-current 741
activation energy 75, 561, 590, 614, 680
AFM *see* atomic force microscopy
alkynylene-bridged zinc
 bispyridylporphyrin rotamers 634, 637
architectures
 dendritic 661, 664–65, 667–69, 673, 675
 fullerene-porphyrin 381
arrays
 dendritic metalloporphyrin 673
 molecular 16, 278, 392, 394, 408, 492, 554
artificial photosynthesis 203, 275, 350–51, 378–79, 381, 429, 532, 579, 656, 662, 694, 699
artificial photosynthetic systems
 349, 371–73, 375, 378, 430, 530
assemblies
 bisporphyrin-fullerene 408
 molecular 10, 45, 295, 303, 427, 499, 501, 526, 528
 porphyrin film electrode 508
association constants 163, 173, 197, 405, 473, 477, 511, 595, 598, 604, 606, 616

- atomic force microscopy (AFM) 290, 294, 317, 466, 468, 479, 486, 684
azulene-fused porphyrins 92, 118, 128, 144–45
- bacteriochlorophylls 29, 289–93, 295, 339, 429
bands, lowest-energy 103, 129, 131
BDP *see* boron dipyrromethene
BDP moiety 398, 400–1
BDPY *see* borondipyrromethene antennas
BDPY conformations 368–69
benzene 26, 96, 100–1, 122, 129, 491, 638, 643, 738
benzonitrile 165, 177–78, 198–99, 201, 203, 323–30, 357, 414, 435, 563, 573, 689
benzyl ether 666–68, 672, 675–76
betaine 372–75, 377
bidentate ligand 71, 79
bisporphyrin 301, 303, 313, 316, 341
bisporphyrin dimer 318
bisporphyrin-fullerene 407
bisporphyrin units 308, 314, 322, 340
blocks, molecular 222–23
boron dipyrromethene (BDP) 398–401
borondipyrromethene antennas (BDPY) 364, 366, 368–70
butadiyne-linked porphyrin dimer 50, 60, 64, 87
- carbon nanotubes 393, 431–32, 464, 493, 495, 500, 523, 525, 527–28, 699
carotenoids 353, 357–58, 372, 380, 385
CB *see* conduction band
- CD *see* circular dichroism
CD moiety 182
CdSe nanoparticles 278–79, 461–62
cetyltrimethylammonium bromide (CTAB) 517, 519
charge recombination (CR) 59, 75–77, 83, 85, 89, 162, 169, 203, 354, 424, 562–63, 576, 679, 689, 710
charge separation (CS) 58–59, 71, 73–75, 85, 89–90, 328, 334–35, 353–54, 371, 375–77, 398–99, 411, 424, 555–57, 709–10
charge transfer 80, 89–90, 140, 152, 184, 186–87, 218, 229, 241, 244, 246, 267, 538, 555, 570
chemical dimers 217, 222–25, 229–30, 237, 240–41, 243, 258, 272, 282–83, 285
chemical sensors, porphyrin-based 630
chromophores 12, 20, 152, 159–61, 188–89, 197–98, 202–3, 209, 291–92, 295, 297–98, 320–21, 349–51, 499–500, 544–45
secondary 738, 740
circular dichroism (CD) 91, 136–40, 142–47, 181, 461, 641, 643–45, 658–60
clusterization 446, 456, 470, 472–73, 476, 481, 490, 534
complementary dimer 297, 299, 303–4, 306, 315, 318, 338–39
complementary dimer units 303, 311, 319, 321
compounds
functional 538, 544
porphyrinoid 91, 99, 106

- conduction band (CB) 52, 427,
 442, 444, 453, 462, 468, 686,
 715, 727, 741, 746
 conformational disorder 80, 85
 conformational dynamics 16–17,
 285
 conformational flexibility 31–32,
 40, 50, 60, 64, 87, 285
 conformational heterogeneities 3,
 12, 15–16, 29, 40–42, 44–45,
 49
 conformations
 nonplanar 240
 orthogonal 4–5
 planar 69, 634, 637
 twisted 18, 20, 61, 64
 conformers 60, 64, 71–72, 75–76,
 230, 551, 637
 conjugated organic dyes 751
 conjugated porphyrin ladders 45,
 87, 757
 conjugates 143, 198–99, 201, 427,
 689
 multiple porphyrin-
 fullerene 406
 constructs
 fullerene-porphyrin 382, 533
 multiporphyrin 443, 472
 core-modified
 tetrabenzoporphyrins 92,
 118, 122, 144
 CR *see* charge recombination
 CS *see* charge separation
 CTAB *see* cetyltrimethylammonium
 bromide
 Cu-cyclodimers 239
 Cu-porphyrin 258, 260
 cuvette 507, 642, 646–48, 650–53
 cyclic arrays 31–32, 35, 37, 40,
 42–43, 45
 cyclic polyenes 98, 100, 104, 112
 cyclic porphyrin wheels 29,
 31–33, 35, 37–44
 two-dimensional 2, 44
 cyclic tetramers 630, 632, 634–37,
 640, 648, 659
 31,51-cyclodimer 230, 232,
 237–38
 cyclodimers 238
 cyclopentaneporphyrins 237,
 283–84
 donor-acceptor distance 549,
 563
 decay 77, 79, 83, 165, 267–68,
 353–54, 357, 368–69, 411,
 422–23, 512–13, 569–70, 573,
 673–74, 677
 distributed 550–51, 569, 572
 decay rates, radiative 9–11
 decomplexation 588, 607, 610–11
 degeneracy 98, 101, 110, 124,
 126, 131, 602
 dendrimer porphyrins 668, 697
 dendrimers 471, 661, 664–74, 696
 multiporphyrin 470, 672, 683
 dendritic multiporphyrin array
 673–74, 699
 dendritic porphyrin-fullerene
 hybrid 689
 dendritic porphyrins 471, 534
 dendritic wedges 643, 666–67,
 674
 density functional theory (DFT)
 64, 84, 88, 91, 138–40, 157,
 240, 712
 depolarization 36–37, 318, 320
 deposition, electrophoretic 445,
 453, 459, 467, 470, 475–76,
 478
 design, molecular 3, 58–59, 333,
 372, 654, 664, 698, 702, 713,
 725, 749
 devices
 molecular 390, 588, 604, 616,
 622
 porphyrin-based 711, 732, 734

- DFT *see* density functional theory
 DHI *see* dihydroindolizine photochrome
 diarylamino groups 707, 709–10, 718–19
 dichloromethane 60–62, 691, 694
 dielectric constant 253, 550, 638
 dihedral angles 16–17, 39, 60, 64–66, 68–71, 112, 516, 644
 dihydroindolizine photochrome (DHI) 372–74, 377
 dimer 8–9, 20, 49, 60, 162, 223–26, 229, 235–36, 242–51, 253–55, 257–63, 304–6, 310–12, 338, 412–14
 bacteriochlorophyll 290–92
 complexed 260, 262
 covalent-linked
 porphyrin-fullerene 470
 covalently-linked 282–83
 metalloporphyrin 435, 658
 mono-*N*-methylimidazolyl-Znporphyrin 316
 non-complexed 259–60
 dimer fluorescence 259, 261
 dimeric porphyrin dyes 702, 743–45, 747
 dimerization 337, 339–40, 412
 crown porphyrin 435
 induced 412, 414
N,N-dimethylaminopyridine (DMAP) 606–9
 10,20-diphenylporphyrin 721, 759
 dipyridyl pyrrole ligand 61–62
 disbalance energy 550
 dissociation 25, 170–71, 190, 313, 408, 412
 21,23-dithiaporphyrin 118–19
 DLS *see* dynamic light scattering
 DLS analysis 478–79
 DMAP *see* *N*, *N*-dimethylaminopyridine
 DMF (dimethylformamide) 169, 199, 256, 261, 422–23, 466, 518–19, 686
 DMF solution 518, 684, 686
 dodecameric porphyrin wheel 53, 276
 donor–acceptor compounds 539, 543
 donor–acceptor dyads 550, 559, 561, 563, 565, 567, 569, 571, 573, 578, 592
 donor–acceptor films 547, 557
 donor–acceptor molecules 71, 286, 538
 donor emission 595–96
 donor polymer 441–42
 DSSC *see* dye-sensitized solar cells
 porphyrin-based 735, 746–47
 DSSC applications 703–4, 708, 749
 DSSC devices 702, 704, 717, 725, 728, 734
 dyads 151–52, 157–60, 164–65, 174, 195–98, 325, 366, 433, 480–81, 537–39, 559–69, 571, 577–78, 601–2, 621
 non-covalent
 porphyrin-acceptor 593
 phthalocyanine-fullerene 570–71, 574, 584–86
 porphyrinfullerene 470, 495, 540, 576, 584
 dye molecules 442, 445, 514, 523, 528, 552, 736, 748
 dye-sensitized solar cells (DSSC) 278, 430, 440, 442–43, 488–89, 577, 701–2, 706, 712–14, 718, 720–26, 734–36, 742–44, 746–52, 754–62
 dyes 16, 268, 430, 440, 443, 521, 701–2, 708–9, 712, 714–15, 723–24, 727–28, 730–32, 742–43, 753–54

- photon absorption 668–69
- dynamic light scattering (DLS) 452–53, 502, 504, 518, 648

- EDG** *see* electron-donating group

- EEH** *see* excitation energy hopping
- EEH rate constant 37
- EET** *see* excitation energy transfer
- EET efficiency 29, 38, 40, 44
- effective excitation energy transfer 665, 670, 675
- electric dipole 68, 94, 96, 100–1
- electric vector 100
- electrical conduction 88
- electrodes 89, 336, 380, 441, 444, 448, 456, 459, 463–64, 473–75, 478–83, 485–87, 528, 547–50, 605
- modified 442, 448, 459, 465, 467–68, 470–71, 473–76, 478–80, 482–83, 486–87, 510, 513
- porphyrin-assembled 336
- electron, injected 747
- electron acceptors 72, 77, 168, 177, 223, 225, 251, 268, 353, 393–94, 415, 420, 435, 557, 560
- electron density 560, 712, 723
- electron-donating group (EDG) 713, 716–17, 719–20, 722, 725, 730
- electron donor 71, 77, 168, 196, 336, 353, 377, 390, 393, 420, 441, 500, 557, 604
- electron exchange 25, 191
- electron–hole pairs 25, 271, 441, 501, 576
- electron injection 83, 279, 454, 468, 482–83, 486, 514, 686, 701, 704, 711, 727–28, 736–37, 747–48, 756–57

- electron spin resonance (ESR) 513
- electron transfer 55–56, 58, 72, 74–78, 86–90, 280, 380–83, 433–34, 449–50, 462–63, 556, 589–90, 609–10, 623, 680–85
- intermolecular 79, 397, 530
- electron transfer mechanism 152, 180, 182
- electron transfer rate constants 329, 363, 365, 520, 682
- electron-transfer reactions 85, 331, 491
- electron wave function 270
- electron withdrawing groups 114
- electronic bands 111, 117
- electronic coupling 3, 9, 16, 22, 44–45, 51, 60, 74–76, 85, 198, 219, 352, 364, 370–71, 715–16
- electronic excitation deactivation 282, 284
- electronic states 70, 103, 142, 147, 247, 637, 639
- electronic structures 91, 98, 108–9, 117, 136, 138, 140, 142–43, 145, 147, 283, 470, 753, 759
- electronic transitions 28–29, 44, 64, 71, 93, 103, 475
- electrons, conduction band 711
- electrostatic interactions 177, 185, 190, 222, 393, 595
- emission decays 527–28, 735–36
- emission dipoles 14, 33–34
- emission spectra 15, 17, 30, 63, 73, 170, 260, 305, 359, 462, 554, 565, 692
- energy gradient 294, 696
- energy levels 103, 152, 194, 328, 396, 462, 470, 715–16, 719, 722, 746
- energy transfer
 - excited 600, 625
 - photoinduced 205, 461–62, 469

- ESR *see* electron spin resonance
excitation density 568–69
excitation energy 38, 69, 71, 76,
85, 139, 152, 292, 294, 298,
305–6, 331, 351–52, 667–68,
677–78
excitation energy density 568–69
excitation energy hopping (EEH)
34–36, 318
excitation energy transfer (EET)
2–3, 10, 29, 38, 44, 48–49, 53,
276, 655, 670, 700
excitation spectra 18–19, 61, 63,
516
exciton coupling 5–6, 29, 31, 53,
71, 186, 384, 635, 657, 744
exciton–exciton annihilation 35,
37–38, 319, 505, 569
excitons 10, 22–23, 25, 35, 48,
269, 271, 298, 335, 441, 486,
501, 506
extinction coefficients 6, 42–44,
167, 291, 338, 357, 461
- fluorescence 11, 16, 156–57,
205–6, 233–34, 242–43, 248,
322, 324, 328–30, 512–13,
605–9, 674, 678–79, 692
porphyrin ligand 268
fluorescence bands 247, 730
extra-ligand 242, 245
fluorescence decay curves 513,
527
fluorescence decay profiles 8,
42–43, 672, 680
fluorescence decays 40, 190, 242,
245, 251, 255, 398, 404, 513,
679, 736
fluorescence excitation spectra 19,
61, 234, 236, 254
fluorescence intensities 5, 7, 21,
175, 182, 260, 321, 397, 422,
467, 526, 610–11
initial 42–43
- fluorescence lifetimes 6–7, 10–11,
13–14, 22, 42–43, 53, 74–75,
203, 320, 329, 334, 340, 458,
513, 527
fluorescence line narrowing 233,
236–38, 282–83
fluorescence methods 546
fluorescence quenching 237, 245,
247, 251, 262, 333–34, 511,
555
fluorescence spectra 18, 31, 115,
196, 236, 238, 242, 248, 260,
330, 333, 421, 458, 497, 616
steady-state 400, 461, 526–27
- fluorescence spectroscopy,
single-molecule 47, 51, 277
- fluorescence titrations 197,
323–24, 329
- fluorescence trapping sites 7,
33–34
- fullerene bi-layer 555
- fullerene derivatives 517–18
- fullerene-donor 431, 530
- fullerene dyads 495, 577,
583–85
- fullerene entities 406, 415
- fullerene moieties 209, 324, 327,
356, 474, 484, 509, 563–66
- fullerenes 199–201, 364–66, 370,
393–94, 433–36, 449–50,
472–74, 480–81, 489–91,
496–97, 500, 508–9, 511,
533–34, 573
- functional groups 545, 640, 665,
669
- functional theory 84, 91, 139–40
- funnel, energetic 666
- generalized gradient
approximation (GGA) 105
- GGA *see* generalized gradient
approximation

- giant multiporphyrin arrays 445, 447, 449, 451, 453, 455, 457, 459, 461
- gold nanoparticles 316–17, 446, 449, 456, 490–91, 533–34, 753
- porphyrin-modified 445, 457–59, 490–91
- heptads 358–59, 362–63, 365–67, 370–72
- heteroarrays 150, 154–56, 167, 171, 177, 188–89, 199, 201, 203, 205, 207, 209
- heterodimers 183–84, 190, 230, 234–35, 239–41, 250
 - free base-zinc porphyrin 558
- heterodimers of
 - ethane-bisporphyrins 234
- hexaphenylbenzene 350, 358–59, 366, 369
- highest occupied molecular orbital (HOMO) 66, 69, 99–103, 108, 112–13, 119–22, 125–26, 129–30, 160, 398–99, 404–7, 417, 600–3, 717, 723
- HOMO *see* highest occupied molecular orbital
- homodimers 230, 233–34, 239
- hybrid diporphyrins 46, 625
- hydrogen bond formation 617
- hydrogen bonding 389, 392, 407, 427, 578, 595, 622, 632, 635, 656
- hydrophilic groups 543–44, 556, 562–64, 571
- imidazolylporphyrin 312–14, 335
- intermolecular bonds 587, 621
- intermolecular forces 296, 333
- intermolecular interactions 191, 282–83, 389, 475, 514, 562, 606, 621–22
- interporphyrin 225, 745
- intramolecular energy transfer 167, 626, 696, 699
- intramolecular exciplex 565, 569
- ion pairs, radical 241, 247, 396, 398, 680, 699
- iron porphyrins 145, 629
- LAC-sensitized solar cells 741–43
- layers
 - photoactive 442, 547
 - polythiophene 555
 - porphyrin–phthalocyanine 558
 - thiacyanine 555
- LD *see* linear dichroism
- LD intensity 650–51
- ligands 57, 60–61, 104, 107–8, 115, 117–18, 131, 169–70, 208–9, 224, 296–98, 326–27, 461–62, 474, 610–11
 - detachable 610–12
 - imidazolyl 293, 297, 312–13, 320
- light absorption 92, 379, 397, 418, 426, 440–41, 457, 474
- light energy 291, 294–95, 331, 377, 379, 390, 584, 666–68
- light energy conversion 496, 500, 529, 533–34, 584, 666
- light harvesting 150, 274–75, 328, 331, 334, 349–50, 352, 354, 356, 358, 360, 362, 364, 384–86, 445
 - light-harvesting antenna complexes 219, 339, 629, 663
- light-harvesting antenna ring 299, 301, 303, 305, 307, 309, 311
- light-harvesting arrays,
 - star-shaped multiporphyrin-phthalocyanine 383
- light-harvesting efficiency 394, 444–45, 721, 724–25

- light-harvesting multiporphyrin arrays 664, 699
light-harvesting porphyrin arrays 744
light intensity, white 375–76
light irradiation, laser 400, 424
light propagation 92–94, 96, 100
linear antenna array 312–13, 315, 317
linear dichroism (LD) 237, 644–45, 648
liquid solutions, degassed 240
lowest unoccupied molecular orbital *see* LUMO
LUMO (lowest unoccupied molecular orbital) 66, 69, 96–97, 99–100, 102–3, 108, 112–13, 115–16, 119–20, 122, 126, 129–30, 160, 404–7, 602
- macrocycles 149–50, 153–54, 156, 159, 164, 166, 171–72, 174, 178, 183–84, 190–91, 194–96, 296–97, 484–85, 629
tetrapyrrole 223, 226–27, 239
macromolecules 385, 647, 664
dendritic 661, 696
macrorings 301, 305–8, 311, 321, 323–31, 333–34, 339–40, 344, 346
magnetic circular dichroism (MCD) 91–92, 110, 115, 119, 126, 128–30, 132, 136–40, 142–47
MCD *see* magnetic circular dichroism
MCD spectra 96, 104, 108, 110, 113–17, 120–21, 124, 131–33, 135, 137
MCD Spectroscopy 91–92, 107, 109–10, 117–18, 120, 127, 129, 132, 135–36, 138, 144
mean molecular area (MMA) 541–42, 544, 561, 563–64, 571, 573
metal porphyrin complexes 98, 113
metalloporphyrin molecules 619
metalloporphyrins 419, 474, 484, 502, 637, 639
2-methyltetrahydrofuran 359, 361, 366, 369, 374
microstates 92, 95, 134–35
MMA *see* mean molecular area
MO (molecular orbital) 66, 68, 87, 96, 98–100, 105, 109, 112, 115, 124, 140–44, 160, 716–17, 722, 740
molecular brightness, relative 42–44
molecular films 537, 546, 585
molecular mechanics 613
molecular orbital *see* MO
molecular recognition 221, 275–76, 529, 630, 639, 653, 658
molecular structures 2–3, 13, 46, 64, 104, 106, 118, 125, 129–30, 137, 172, 178, 185, 207, 698
molecular switches 604, 622, 626–27
molecular systems 33, 291, 391, 408, 431, 530, 538, 546, 552
molecular wires 16, 49, 55–58, 83–84, 86, 88–90, 316, 696, 759
porphyrin-based 56–57, 76, 86, 90, 281
molecular wiring 316–17
molecule-substrate interactions 620
molecules 7–9, 11, 226–28, 266–70, 353, 356, 371–72, 375, 377–78, 442–43, 445–46,

- 448, 539–45, 563–64,
587–88
ambiaromatic 137
chromophoric 637
functional 392, 545, 560
porphyrin-trptycene 591
monolayers 189, 482–83, 540,
543–47, 564, 571
self-assembled 335, 445, 490,
578–79, 586
multichromophores 273, 318
multilayer film deposition 545,
571
multilayer films 188, 277, 543,
545, 554, 576–77, 585
multiporphyrin arrays 1, 55, 91,
149, 217–18, 222, 226–29,
239, 383–84, 439–40, 444,
458–60, 498–99, 691, 700–1
complex 241
cyclic 284
fullerene-terminated dendritic
678–79, 699
giant 472
large dendritic 698
polyoxometallate-appended
686–87
self-assembled 218
self-assembled nanoscale 217
similar 457
supramolecular heptadecameric
675
synthetic 286, 625–26, 752
multiporphyrin complexes 223,
242, 258–59, 261, 263, 265,
288
self-assembled 218, 223, 243
multiporphyrin dendrimers 670
multiporphyrin structures 272,
288
multiporphyrin systems 224, 280
multiporphyrins 389
self-assembled 226, 630
nanoparticles 458–62, 482–83,
501–2, 504–7
porphyrin-modified 458,
461–63

OAM *see* orbital angular
momentum
OAM properties 105, 112, 118,
124–25
octadecylamine 541–42, 545, 553,
558, 560, 563–64, 568, 571,
580
octaethylporphyrins 240, 312
oligomers 48–49, 55, 57, 70–71,
78, 85, 315, 430, 474
optical spectra 91, 106, 108, 110,
117, 119, 122, 124–25, 136,
140, 146
optically transparent electrode
(OTE) 447, 507, 527
orbital angular momentum
(OAM) 100, 102, 112
organic molecules 221, 227, 229,
281, 445, 500–1, 538, 628
OTE *see* optically transparent
electrode
oxoporphyrinogen 415

pentads 153, 223–24, 226,
259–62, 272, 375, 377, 436,
599
pentamer 300–1, 303, 305, 312,
321, 698
PET *see* photoinduced electron
transfer
photo-voltage measurements
549–50, 563, 567
photo-voltage responses 561–62,
565–67, 573, 575–76
photobleaching 6–7, 20, 33
photobleaching dynamics 5, 7, 11,
20–21, 44

- photochromic moiety 373–74
photocurrent action spectra 456,
 468, 473–74, 476, 479, 482,
 511
photocurrent generation 454,
 468–70, 474, 482–83, 486–87,
 490, 493, 496, 498, 514, 556,
 710
photodynamic therapy 108, 220,
 222, 279, 668, 697
photoelectrochemical cells
 442–43, 475–76, 488, 507–8,
 516, 526, 536, 585
photoexcitation 6, 13–14, 25,
 27–28, 31, 42, 150, 174, 178,
 184, 187, 189, 199, 202, 209
photoinduced electron transfer
 (PET) 58, 167–68, 219,
 261–63, 352–55, 369–70,
 377–78, 381–83, 385–87,
 430–33, 519, 536–39, 579–83,
 585–86, 686–87
photoisomerization 374, 610–11,
 614, 627, 696
photon energy 352–53, 377, 663
photons 22–23, 35, 38, 51, 92,
 100–1, 221, 351, 427, 500,
 587, 621, 666
photosynthesis 219, 274, 295,
 335, 343, 349–52, 355,
 371–72, 379–80, 385, 390,
 401, 428, 440, 662
photovoltaics 149–50, 428, 500–1,
 517, 528, 761
phthalocyanines 98, 109, 127,
 136, 138, 140, 144–45, 191,
 295–96, 337–40, 393–94,
 414–15, 571, 573, 585
porphyrin absorption 235,
 469–70, 708
porphyrin absorption bands 266,
 738
porphyrin absorption spectra 717,
 724, 738, 742
porphyrin arrays 2–3, 5, 10,
 44–45, 47–49, 52, 54, 335,
 384, 486, 625, 656, 669, 705,
 744
butadiyne-linked linear 2,
 16–17, 19, 21, 23
conjugated 16, 25
dendritic 670, 681
fused 16, 29
linear 32, 51, 88, 321, 340
porphyrin assemblies 598, 600,
 616–17, 619, 664
porphyrin bands 375, 522
porphyrin-based dye-sensitized
 solar cells 718, 747
porphyrin brushes 484, 487
porphyrin cations 577, 719
porphyrin chemistry 56, 282, 290
porphyrin chromophore 359, 569
porphyrin clusters 475, 496, 533
porphyrin complexes 98, 106,
 133, 140, 274
porphyrin components 462, 634,
 637
porphyrin core 449, 600, 603,
 620, 703–4, 709–10, 715–16,
 719–20, 722
 focal 670, 672
porphyrin dendrimers 514, 534,
 569, 665, 667, 669, 671, 673,
 675–77, 679, 681–83, 685,
 687, 689, 698
porphyrin derivatives 500, 539,
 555, 591, 661, 663, 668
porphyrin dimers 5, 45–46, 61, 70,
 72, 284, 303, 305, 338, 496,
 534, 744, 746, 756
 co-facial 412
 fused 745
 imidazolyl-coordinated 312
porphyrin disks 616
porphyrin donors 538, 623
porphyrin dyads 365, 600

- porphyrin dyes 499, 705, 713–15,
 721–22, 731, 734, 744, 749
 porphyrin emission 462, 486
 porphyrin excitation 357, 462
 porphyrin films 556, 754
 aggregated 557
 porphyrin–fullerene array 484
 porphyrin–fullerene dyads 277,
 480–81, 490, 497, 537, 541,
 551, 561–64, 571, 578, 580,
 582–86, 699
 porphyrin–fullerene layers 579,
 585
 porphyrin ligands 97, 110, 112,
 228, 266, 268, 461
 porphyrin macrocycles 240, 253,
 269, 402, 553–54, 564, 614,
 712, 715, 737, 744, 748
 porphyrin macrorings 306, 324,
 341
 porphyrin meso-positions 57, 738
 porphyrin-modified microparticle
 458–59
 porphyrin-modified silica
 microparticles 455–57, 491
 porphyrin moieties 1, 16–17, 272,
 365, 375, 451, 453, 461, 469,
 511, 566
 porphyrin molecules 27, 227–28,
 271, 616–17, 620–21
 porphyrin monomers 27, 30, 48,
 61, 384, 753
 porphyrin nanoassemblies 502–4
 porphyrin nanoparticles 501–4,
 530
 preparation of 502–3
 porphyrin oligomers 58–60, 71,
 76–77, 79, 509
 butadiyne-linked 57, 60, 77, 84
 conjugated 49, 58, 77, 86, 696,
 756, 759
 porphyrin-peptide oligomers 472,
 509–11
- porphyrin planes 64, 66, 299, 303,
 317, 412, 722
 porphyrin residues 458, 461, 467,
 700
 porphyrin rings 449–50, 458, 706,
 744
 porphyrin sensitizers 703–4, 707,
 712, 717, 737, 743, 749
 porphyrin substituents 298, 497,
 760
 porphyrin synthesis 313, 657
 porphyrin triads, self-assembled
 241, 280
 porphyrinfullerene 355, 583
 porphyrinfullerene
 donor–acceptor systems 546
 porphyrinoid complexes 108, 131
 porphyrinoid research 123, 135
 porphyrinoid systems 149, 500
 porphyrinoids 56, 91–92, 94, 96,
 98, 100, 102, 104–8, 110, 112,
 114, 116, 122, 130–32,
 134–36
 low-symmetry 117, 119, 121,
 123, 125, 127, 129
 non-planar 110, 120, 138
 ring-expanded 116
 symmetric 95, 100, 106,
 109–10, 130
 porphyrins 56–57, 282–84,
 295–300, 359–66, 374–75,
 448–52, 473–80, 498–502,
 506–28, 552–54, 561–66,
 617–20, 702–9, 711–13,
 715–32
 ferric 401, 433
 fused 746–47
 giant supramolecular 631
 meso-pyridyl-substituted 227
 metal 97, 616, 691
 monomeric 235, 475–76
 oxidized 454, 514, 725
 pyridyl-substituted 218, 223
 self-assembled 515–16

- purple bacteria 289, 292–93, 295, 339, 343, 391, 662–64
pyridine 57, 61, 70, 79, 113, 128, 132, 164, 171, 179, 251–53, 310, 317–18, 421, 690
pyrrole moieties 110, 112, 116, 127, 615, 619
- quantum efficiencies 76, 237, 267, 331, 672
- radical ion pair (RIPs) 208–9, 241, 246–47, 249–51, 396, 398–99, 401, 404, 406, 411–12, 415, 427, 680, 691, 699
RIPs *see* radical ion pair 208–9, 241, 246–47, 249–51, 396, 398–99, 401, 404, 406, 411–12, 415, 427, 680, 691, 699
ruthenium porphyrins 617, 694
- SA *see* stearic acid
SAMs *see* self-assembled monolayer
scanning electron microscopy (SEM) 456, 518, 648
scanning tunneling microscopy (STM) 301, 303–4, 316, 342, 616, 619, 621, 628
self-assembled monolayer (SAMs) 335, 445, 490, 538, 578–79, 586
SEM *see* scanning electron microscopy
sensitizers 444, 702–3, 709, 746, 761
silica nanoparticles, porphyrin-modified 457–58, 491
silica particles, porphyrin-modified 454
single-walled carbon nanotubes 420, 684
solar cells 55, 108, 426, 430, 440, 444, 489, 582, 728, 730, 741, 743, 751–52
organic 577–78
porphyrinsensitized 720, 759
solar energy 350, 390–91, 430, 661–62, 681, 702
stearic acid 545, 547, 553, 555, 560
stearic acid (SA) 544–45, 547, 553, 555, 560
STM *see* scanning tunneling microscopy
sunlight 350–51, 440, 500, 662–63, 666, 733, 760
supramolecular arrays 389, 392, 695
multiporphyrin-SWCNT 389
supramolecular assemblies 56, 84, 177, 180, 191, 193–94, 220, 384, 427, 464, 470, 493, 524–25, 528
supramolecular chemistry 56, 194, 221, 275, 290, 429, 529, 533, 622, 639–40
solution-based 191
supramolecular chiral chemistry 639
supramolecular complexes, bisporphyrins-fullerene 405
supramolecular donor–acceptor dyads 592
supramolecular electron transfer 589, 591, 593
supramolecular energy transfer 595, 597, 599, 601, 603
supramolecular ensemble 177–78, 208
supramolecular nanofibers 647–48, 651

- supramolecular polymer 635, 643, 647
supramolecular porphyrin assemblies 616
supramolecular switches 588, 604, 609–10
supramolecular triads 178, 395, 400–1
supramolecules 427, 592, 610, 626
- TAA *see* transient absorption anisotropy
tetraacenaphthoporphyrins 106
tetrabenzoporphyrins 106, 123
tetrads 156, 199, 201, 205, 225, 412
tetrahydrofuran-toluene 233–34
tetrahydroporphyrin 227, 250, 259, 268
tetraphenylporphyrin 106, 118, 135
21-thia-23H-porphyrin 119
21-thiaporphyrin 118
titration 173, 176, 180, 185–87, 190, 224, 260, 269–70, 324, 334, 683, 738
TPA *see* two-photon absorption
transient absorption anisotropy (TAA) 3, 29, 48, 318
triads 59, 87, 154, 196, 198, 202–3, 205–6, 209, 223–25, 241–48, 250–51, 253–55, 257–59, 354–55, 397–99
carotene-porphyrin-fullerene 354
ferrocene-porphyrin-fullerene 59, 77
trimers 7–8, 217, 223–24, 226–27, 229, 258, 263, 272, 312
trifluoromethylsilyl 117
trisporphyrin 310, 323, 325–26, 333
tunability, chemical 229, 272
twisted conformer 17–20, 63, 69, 71–72, 74
two-photon absorption (TPA) 129, 142, 198
- vortex flows 642–43, 645, 660
- zinc porphyrin array 679
zinc porphyrin dimer 408–9
zinc porphyrin moiety 678
zinc porphyrin nanocluster 635
zinc porphyrin supramolecular box 637
zinc porphyrins 57, 355, 365–66, 369–70, 386, 395, 433–37, 449, 474, 484, 486, 558, 632, 657–58, 703
isoenergetic peripheral 357
peripheral 356
Zn-cyclodimers 237–38

