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Supplementary Material for

Hydrogels: Soft Matters in Photomedicine

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Table S1 Illustrative Nano/Hydrogel systems with covalently bound photosensitizers.

Hydrogel-type	Monomer	Cross-linker	Other components	Photosensitizer[a)]	Targeting moiety	Size [nm]	PDT studies	Ref.
Phenothiazines								
PAA	Acrylamide, 3-(aminopropyl)methacrylamide	3-(Acryloyloxy)-2-hydroxypropylmethacrylate	PEG	Methylene blue	F3 peptide	50-60	*in vitro*: 9L, MDA-MB-435, F98	308
PAA	Acrylamide, 3-(aminopropyl)methacrylamide	Glycerol dimethacrylate	PEG	3,7-Bisallylmethylene blue	F3 peptide	50-110	MDA-MB-435	309
PAA	Acrylamide, 3-(aminopropyl)methacrylamide	Glycerol dimethacrylate	PEG	3,7-Bismethylacrylamide methylene blue	F3-peptide	30-100	*in vitro:* MDA-MB-435	309
PAA	Acrylamide, *N,N*-dimethylaminoacrylamide	*N,N'*-methylenebisacrylamide	APS TEMED	3-(2-(2-(2-Acrylamidoethoxy)ethoxy)ethylamino)-7-(dimethylamino) phenothiazin-5-ium chloride		166	Antimicrobial *in vitro*: *S. aureus, E. coli*	417
Porphyrins								
PpIX-PNIPAM	*N*-Isopropylacrylamide	Protoporphyrin IX	PVA, MBA	Protoporphyrin IX		200-300	*in vitro*: HT-29 cells	185
PpIX-DME-PNIPAM	*N*-Isopropylacrylamide	Protoporphyrin IX dimethylester	PVA, MBA	Protoporphyrin IX dimethylester		317	*in vitro*: HT-29 cells	185
PNIPAM-coCAA-TPP	*N*-Isopropylacrylamide	5,10,15,20-Tetrakis(4-N-carbonylacrylicaminophenyl)porphyrin	MBA	5,10,15,20-Tetrakis(4-N-carbonylacrylicaminophenyl)porphyrin		66	*In vitro:* A453 cells	223
PAA	*N,N*-Dimethylaminoacrylamide	*N*-(6-Aminohexyl)acrylamide		Haematoporphyrin				326
CS/NH_2-TPP/FA	Chitosan	*5*,10,15,20-Tetrakis(4-aminophenyl)porphyrin [=NH_2-TPP], 2,4,6-tris(*p*-formylphenoxy)-1,3,4-triazine [=TRIPOD]	TRIPOD	NH_2-TPP	Folic acid [=FA]	200-400	*in vitro*: FR+ MCF-7 and FR- HepG2 cells	352
BODIPYs								
Chitosan	Chitosan	3,5-Diformyl-BODIPY		3,5-Diformyl-BODIPY				387
Phthalocyanines								
Chitosan		PS-tetraaldehyde		(Tetrakis(4-(4-formylphenoxy)phthalocyaninato)zinc(II)		20-50	*in vitro*: MDA-MB-231, A435	376
Chlorins								
PAA	Acrylamide, 3-(aminopropyl) methacrylamide	Glycerol dimethacrylate	PEG, cyanine dye for imaging	2-Devinyl-2-(1-hexyloxyethyl) pyropheophorbide a	F3-peptide	44	*in vitro:* MDA-MB-435	359
Pba-PNIPAM	*N*-Isopropylacrylamide	Pheophorbide a	PVA, MBA	Pheophorbide a		283	*in vitro*: HT-29 cells	185
Pullulan				Pheophorbide a	Folate	171	*in vitro*: HeLa; *in vivo*: male Balb/C-nu mice	373
Ce6-cELP	cysteine-containing elastin-like polypeptide	Chlorin e_6		Chlorin e_6			*in vivo:* human squamous cell carcinoma (FaDu) cell line in mouse model	369

a) Name of the parent compound, not necessarily the exact compound used for hydrogel construction.

Table S2 Illustrative nanomaterial/hydrogel systems with encapsulated photosensitizers.

Photosensitizer	Nanomaterial/Hydrogel type	Special features	Co-drug	Size [nm]	PDT studies	Ref.
Phenothiazines						
Methylene blue	Chondroitin sulfate tyramine conjugates	Tyrosinase-mediated cross-linking				313
Methylene blue	PAA			20-30	*in vitro:* rat C6 glioma tumor cells	306,307
Methylene blue	aerosol OT-alginate			72	*in vitro*: MCF-7, 4T1	310
Methylene blue	aerosol OT-alginate		doxorubicin	62	*in vitro:* NCI/ADR-RES	311
Methylene blue	PAA				antimicrobial: *Staphylococcus aureus*, *Escherichia coli* K-12, *Pseudomonas aeruginosa* PAO1, *Acinetobacter* sp. strain AC811	413
Methylene blue	PVA, borate				clinical methicillin-resistant *Staphylococcus aureus* (MRSA) isolate (MRSA 180)	415
Methylene blue	MB hydrogel	MB as liposomal formulation			Clinical: successful treatment of mild to moderate *Acne vularis* in 90% of 13 patients	314
Methylene blue	MB hydrogel	MB as liposomal formulation			Clinical: treatment of truncal *Acne vularis* in 35 patients	315
Methylene blue	MB hydrogel	MB as liposomal formulation			Clinical: successful treatment of 16 patients with resistant plaque psoriasis	316
Methylene blue	MB hydrogel	MB as liposomal formulation			Clinical: successful treatment of 11 patients out of 17 with nodular basal cell carcinoma	317
Methylene blue	Gantrez_ AN139 (copolymer of methyl vinyl ether and maleic anhydride, cross-linked with PEG 10000)	Iontophoteric release			*in vitro* antimicrobial: clinical methicillin-resistant *Staphylococcus aureus*, *Burkholderia cepacia*	425
Methylene blue	Chitosan	Upconverting nanoparticles: $NaYF_4$:Er/Yb/Mn methylene blue-doped silica		30	*in vitro* antimicrobial: *S. aureus, E. coli*	419
Methylene blue	Chitosan				Antimicrobial *in vitro: P. acnes*	410
Toluidine blue	Carboxymethylcellulose	Dye as liposomal formulation			*in vivo:* BALB/c mice with Ehrlich subcutanous tumor	318
Toluidine blue	Hydroxypropyl methylcellulose/chitosan				Antimicrobial *in vitro: Staphylococcus aureus, Pseudomonas aeruginosa*	416
Toluidine blue	Hydroxypropyl methylcellulose/chitosan				Antimicrobial *in vitro*: biofilms of *Staphylococcus aureus*, *Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis*	319
Toluidine blue	Carbomer				Antimicrobial *in vitro*: *Staphylococcus aureus, Escherichia coli*	320
Xanthenes						
Rose bengal	Carboxymethylcellulose	Topical application to healthy skin			*in vivo*: safety and pharmacokinetic study on mice and rabbit skin	321
Rose bengal	AquaGel	Topical application to healthy skin			*in vivo*: safety and pharmacokinetic study on mice and rabbit skin	321
Rose bengal	LiquaGel	Topical application to healthy skin			*in vivo*: safety and pharmacokinetic study on mice and rabbit skin	321
Rose bengal	Carboxymethylcellulose	multivesicular liposome formulations of PS		2100	*in vivo*: skin penetration in healthy albino mice	322
Rose bengal	Carboxymethylcellulose	liposome formulation of PS incorporated into hydrogel			*in vivo: 15 female patients, facial white terminal hair study*	323
Perylene quinones						
Hypocrellin B	Ca-Alginate	Folate units for targeting	doxorubicin	3000-4000	*in vitro*: HeLa cells	324
Porphyrins						
ALA	poly(methylvinylether/maleic acid)	Micro needle array, esterification reaction between polymer and glycerol		Height: 280 000; diameter: 240 000	Neonatal porcine skin insertion studies	332

ALA	Poloxamer 407 (Pluronic F127)	Thermosetting gel		*Clinical:* fluorescence diagnostic of CIN	330
ALA hexyl ester	Poloxamer 407 (Pluronic F127)	Thermosetting gel		*In vivo:* skin update in nuce mice	329
ALA hexyl ester	Poloxamer 407 (Pluronic F127)	Thermosetting gel		*Clinical:* fluorescence diagnostic of CIN	331
*m*THPP	Chitosan PMMA			*in vitro*: C14 cell uptake	350
*m*THPP	Carboxymethyl starch and dextran sulfate		40-100		351
5,10,15,20-Tetrakis(4-O-phenyl)porphyrin-cored poly(ε-caprolactone)-block-PEG	Porphyrin copolymer and α-cyclodextrin	Supramolecular inclusion doxorubicin complex			353
TMPyP tetra tosylate	Chitosan/alginate	anti-DR5 antibody for targeting; rhodamine 6G	560	*in vitro:* HCT116	346
TMPyP tetra tosylate	Glycol chitosan and dibenzaldehyde-terminated telechelic PEG	–	n.d.	*in vitro*: U14. *in vivo:* U14 tumor-bearing female BALB/c-nu mice	347
TMPyP tetra tosylate	poly(methylvinylether/maleic acid)	Micro needle array, esterification reaction between polymer and glycerol	Height: 280 000; diameter: 240 000	Neonatal porcine skin insertion studies	332
TMPyP ???	Acrylate hydrogel (MMA, MAA, HEMAG	PS counterion not specified	n.d.	antimicrobial: *S. aureus*, *Pseudomonas aeruginosa*	407
TMPyP ???	Methacrylic acid and 2-hydroxyethyl methacrylate copolymers	PS counterion not specified		Good $^1O_2$ production *Staphylococcus epidermidis* inhibition in light and dark	192 420
TMPyP tetra tosylate	Gantrez_ AN139 (copolymer of methyl vinyl ether and maleic anhydride, cross-linked with PEG 10000)	Iontophoteric release		*in vitro* antimicrobial: clinical methicillin-resistant *Staphylococcus aureus*, *Burkholderia cepacia*	425
TMPyP tetra tosylate	PVA, borate			clinical methicillin-resistant *Staphylococcus aureus* (MRSA) isolate (MRSA 180) cultured from the skin of a hospitalised patient; good PDI effect in presence of calf serum and as biofilm	415
TMPyP tetraiodide	Carbopol	TMPyP - poly(lactic-co-glycolic acid) nanoparticles		ROS generation and permeation through pig ear skin study	348
5-[4-2-(2-(2-Acrylamidoethoxy)ethoxy)ethyl]carboxy-phenyl-10,15,20-tris(4-*N*-methylpyridyl)porphyrin trichloride	PAA		140	Antimicrobial *in vitro: E. Coli*	418
[?] $TPPS_4$	PVA	PS counterion not specified	80-950	*In vitro:* HUVEC endothelial cells	349
[?] $TPPS_4$	Methacrylic acid and (2-diethylamino)ethyl methacrylate copolymers	PS counterion not specified		Low $^1O_2$ production	192
Chlorins					
*m*THPC	PAA	Ultrafine particles	2-3	*in vitro*: rat C6 glioma cells	363
*m*THPC	Carbomer	PS as liposomal dispersion containing S-75 and S-100 phospholipids	90-100	*in vitro*: skin penetration studies	364
Chlorin e_6	Starch (PEG-Ce6) nanogel		1000-1500	*in vitro*: A549 tumor cells	367
Chlorin e_6	Hyaluronate-chitosan nanogel		100	NO production, *in vitro*: RAW 264.7, L929 and NIH-3T3 cells; *in vivo*: murine model of rheumatoid arthritis	368
Chlorin e_6	I-fluorenylmethoxycarbonyl diphenylalanine (Fmoc-FF)/poly-L-lysine (PLL) hydrogels		50-100	*in vivo*: MCF-7 breast cancer cell line - mouse model	369
Photodithazine	Natrosol			Antimicrobial *in vitro*: *C. albicans* and non-albicans *Candida*;	371
Photodithazine	Natrosol			Clinical: 5 cases studies of denture stomatitis	372
Chlorophyll	*Spinacia oleracela* extract, poly(ethylene glycol)double acryclates			*in vitro:* Hela and Chinese hamster ovary (CHO) cells	374
Phthalocyanines					
Al(III)Pc(OH)	Pluronic/Carbopol			*In vivo:* effect on systemic parameters in mice	379
Zn(II)Pc	PEG double acrylate, PEG400 hybrid hydrogel	Zn(II)Pc and phototungstic acid or *in situ* photopolymerization		*in vitro:* HeLa cells	377
Zn(II)Pc	Aloe vera–Pluorinic F127			$^1O_2$ generation	378

(Tetrasulfonatophthalocyaninato)zinc(II)	poly-β-cyclodextrin	Supramolecular complex. Concomitant generation of $^1O_2$ and NO		$^1O_2$ and NO generation	380
(Tetrasulfonatophthalocyaninato)zinc(II)	Hydroxypropyl cellulose, cucurbit[8]uril	PS loaded into virus like particles		*in vitro:* RAW 264.7 macrophage cells	272
Inorganic Materials					
[Ag]: Ag/Ag@AgCl/ZnO	CMC	encapsulated		Antimicrobial *in vitro*: *E. coli* and *S. aureus*, wound healing *in vivo* studies with male Wistar rats	392
[Mo] $Na_2[Mo_6I_8(1\text{-OOC-}1,7\text{-}closo\text{-}C_2B_{10}H_{11})_6]$	β-Cyclodextrin polymer assembly	Self-assembly	200	ROS generation	128
[Pt]: platinum(IV) complex-based prodrug monomer (PPM)	methacryloyloxy ethyl phosphorylcholine	reverse addition-fragmentation chain transfer polymerization	100-120	*in vivo*: subcutaneous tumor models (A549-and A549R-xenografted mouse models) and one superficial carcinoma (*in situ* B16 mouse model)	391
[Ru] $Ru(dpp(SO_3)_2)_3$	PAA		20-25	$^1O_2$ production	390
[Ti] TiO_2	PEG double acrylate	*in situ* photopolymerization and $^1O_2$ generation	5×20 rods	*in vitro*: HeLa. Formation of photocytotoxic hydrogel shell around cells	393

Table S3 Illustrative hydrogels for PDT/photothermal therapy.

Active Agent	Nano/Hydrogel type	Features	Co-drug	Excitation [nm]	Study	Ref.
Organic materials						
Coomassie brilliant blue	PAA	covalent	–	590 (LED)	PTT; *in vitro*: HeLa-229, PTT-induced photothermolysis	433
Polyaniline	Chitosan with self-doped polyaniline side chains	Covalent, *in situ* formation of gel at pH 7	–	808	PTT; *in vitro*: Hep3B; *in vivo*: athymic nude mice (BALB/cAnN.Cg-Foxn1nu/CrlNarl) subcutaneous Hep3B tumor	434
Inorganic materials						
[Au]: AuNP	Collagen	Formation of AuNP from $HAuCl_4$ via biomineralization	TMPyP	635	PDT+PTT; *in vivo*: MCF-7 tumor-xenografted mouse model of CRC	187,452
[Au]: Au-nanorods and spinach extract	Spinach extract/PEGDA	Composite of spinach extract, Au nanorods and PEGDA	–	660	PDT+PTT; *in vitro*: HeLa	445
[Au]: (siRNA)–gold nanospheres	Oxidized dextran and poly(amidoamine) G5 dendrimer	gold nanoparticles mediated heat generation under NIR irradiation, causing drug release and thermally induced cell damage		808	*in vivo:* mouse model MCF-7 tumor cells	451
[C]: Graphene oxide (reduced) + [Au]: AuNP	Amaranth extract	Composite of amaranth extract, AuNP and reduced graphene oxide via *in situ* laser irradiation (808 nm) for gelation		660	PDT+PTT; *in vitro*: HeLa	446
[C]: Graphene oxide (reduced) + [Au]: Au nanocages	Spinach extract	Composite of spinach extract, AuNP and reduced graphene oxide via *in situ* laser irradiation for gelation		660	PDT+PTT; *in vitro*: HeLa	447
[C]: Graphene oxide (reduced)	Brassica chinensis extract			650	PDT+PTT; *in vitro*: HeLa, CHO	448
[Cu]: mesoporous silica (mSiO2) modified CuS nanoparticles (NPs)	NIPAAm	radical polymerization		808	Antimicrobial in vitro: *Staphylococcus aureus* and *Escherichia coli; in vivo:* wound healing study with Male Wistar rats model	453
[P]: Black phosphorous	Agarose	encapsulated	Doxorubicin		*in vitro*: MIH3T3, MCF-7; *in vivo*: mice bearing MDA-MB-231 tumor; thermally controlled drug release	436
[Pt]: H_2PtCl_6 in G5 polyamidoamine dendrimer	Alginate	Encapsulated			PTT: *in vitro*: MDA-MB-231; *in vivo*: BALB/c nu/nu mice subcutaneous PC-9; on-demand degradation of hydrogel and renal secretion by injection of chelating agent	435
[Ti] TiO_2 and multiwalled carbon nanotubes	PEG double acrylate	*in situ* photogelation	Doxorubicin	320	PDT+PTT; *in vitro*: MCF-7; *in vivo*: S180 tumor bearing mice	449