What is claimed:

1. Use of near-infrared (NIR) absorbing heptamethine dye in the preparation of a near-infrared-(NIR) photoactive direct treatment composition for use with near-infrared light in the presence of oxygen in the treatment of an ocular tissue in a patient having or at risk of developing a deformation condition of the ocular tissue;

wherein the ocular tissue is a structural tissue that establishes and/or maintains the shape of an eye of the patient; and

wherein the near-infrared (NIR) absorbing heptamethine dye generates singlet oxygen when irradiated with near-infrared light in the presence of oxygen; and

wherein the treatment comprises irradiating the near-infrared (NIR) photoactive direct treatment composition that is in contact with or has permeated the ocular tissue with the near-infrared light in the presence of oxygen, the irradiating resulting in a change in a mechanical and/or chemical property of the ocular tissue that strengthens the ocular tissue, stabilizes the shape of the ocular tissue shape, and/or changes the shape of the ocular tissue.

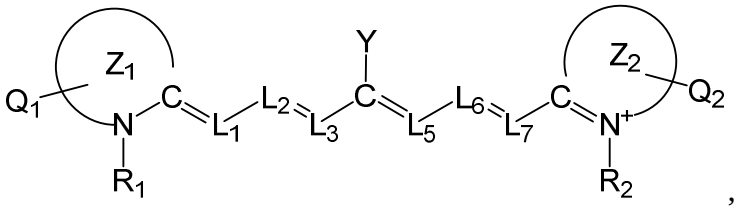
2. The use of claim 1, wherein the mechanical and/or chemical property is tensile strength, compression strength, flexural strength, modulus, elongation, or toughness of the ocular tissue.

3. The use of claim 1, wherein the ocular tissue includes at least a portion of a cornea, a sclera, or a lamina cribrosa.

4. The use of claim 1, wherein the deformation condition of the ocular tissue comprises one or more of degenerative myopia, regular myopia, scleral staphyloma, keratoconus, or glaucoma.

5. The use of claim 1, wherein the near-infrared (NIR) photoactive direct treatment composition is to be administered to the ocular tissue of the patient, either topically or by injection.

6. The use of claim 1, wherein the near-infrared (NIR) absorbing heptamethine dye comprises a structure of:



,

or a rotational or conformational isomer or a salt thereof;

wherein

L_1, L_2, L_3, L_5, L_6, and L_7 are substituted or unsubstituted methines, wherein the optional substituents are independently $C_{1\text{-}6}$ alkyl or $C_{2\text{-}6}$ alkenyl; or L_1 and L_3, or L_3 and L_5, or L_5 and L_7 may be linked with a $C_{2\text{-}4}$ alkylene or $C_{2\text{-}4}$ alkenylene substituent to form a 5- to 7-membered ring;

each of $Z^1$and Z^2 is independently a five- or six-membered nitrogen-containing heterocyclic ring, optionally fused to another aryl or heteroaryl ring;

each of Q_1 and Q_2 is independently H or a substituent positioned on the five- or six-membered nitrogen-containing heterocyclic ring and/or the optionally fused aryl or heteroaryl ring, each optional substituent comprising an optionally substituted $C_{1\text{-}12}$ alkyl, -$[CH_2\text{-}CH_2\text{-}O\text{-}]_{1\text{-}6}R^{10}$, $C_{2\text{-}12}$ alkenyl, polyglycol optionally substituted 5- or 10-membered aryl or heteroaryl group, halo (fluoro, chloro, bromo, iodo), nitro, cyano, -($C_{0\text{-}12}$alkyl) sulfonate or a salt thereof, -($C_{0\text{-}12}$alkyl) sulfate or a salt thereof, -($C_{0\text{-}12}$alkyl)phophate or a salt thereof, -($C_{0\text{-}12}$alkyl)hydroxy, -($C_{0\text{-}12}$alkyl)alkoxy, -($C_{0\text{-}12}$alkyl)aryloxy, -($C_{0\text{-}12}$alkyl)$NHSO_3R_{10}$ or a salt thereof, -($C_{0\text{-}12}$alkyl)$COOR^{10}$ or a salt thereof, -($C_{0\text{-}12}$alkyl)$CON(R^{10})_2$, -($C_{0\text{-}12}$alkyl)$N(R^{10})_2$ or a salt thereof, -($C_{0\text{-}12}$alkyl)borate,

R_1 and R_2 is independently $C_{1\text{-}12}$ alkyl, -$[CH_2\text{-}CH_2\text{-}O\text{-}]_{1\text{-}6}R^{10}$, -($C_{0\text{-}12}$alkyl)amino acid residue, or a 5- or 6-member ringed aryl or heteroaryl, each of which may be optionally substituted with one or more -($C_{0\text{-}12}$alkyl)(SO_3)-R^{10} or a salt thereof, -($C_{0\text{-}12}$alkyl)(SO_4)-R^{10} or a salt thereof, -($C_{0\text{-}12}$alkyl)(PO_4) -R^{10} or a salt thereof, -($C_{0\text{-}12}$alkyl)OR^{10}, -($C_{0\text{-}12}$alkyl)$NHSO_3R^{10}$ or a salt thereof, -($C_{0\text{-}12}$alkyl)$COOR^{10}$ or a salt thereof, -($C_{0\text{-}12}$alkyl)$CON(R^{10})_2$, -($C_{0\text{-}12}$alkyl)$N(R^{10})_2$ or a salt thereof or -($C_{0\text{-}12}$alkyl)borate or borate ester;

R^{10} is independently H or $C_{1\text{-}6}$ alkyl; and

Y is H, or an optionally substituted amine, optionally substituted alkyl, optionally substituted alkoxy, optionally substituted aryl, optionally substituted heteroaryl, optionally substitutedaryloxy, optionally substituted heteroaryloxy, halogen, or optionally substituted cationic heteroaryl moiety.

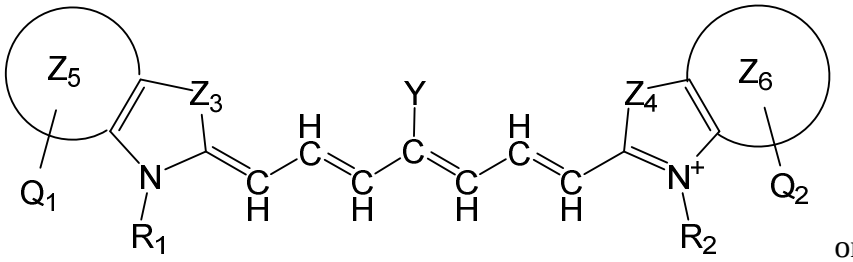
7. The use of claim 6, wherein:

(a) the five- or six-membered nitrogen-containing heterocyclic rings of Z_1 and Z_2 independently comprise a pyrrole ring, imidazole ring, isothiazole ring, isoxazole ring, oxadiazole ring, oxazole ring, pyrazole ring, pyrimidyl, thiazole ring, selenazole ring, thiadiazole ring, triazole ring, or a pyridine ring;

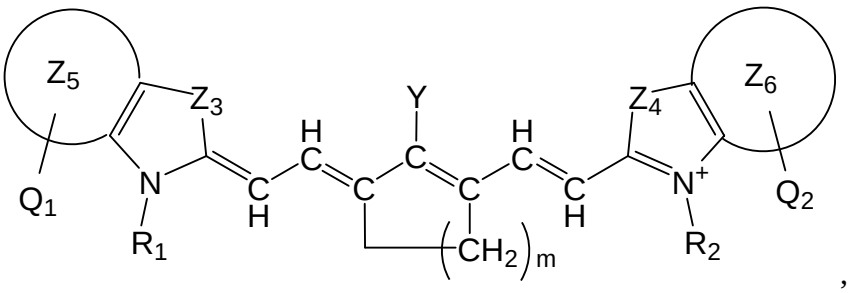
(b) the five- or six-membered nitrogen-containing heterocyclic rings of Z_1 and Z_2 are independently fused to a phenyl, naphthyl, pyridinyl, quinolinyl, quinoxalinyl, N-alkyl-benzoindolenine, dibenzofuranyl, or dibenzothiophenyl; and / or

(c) Z_1 and Z_2 independently comprise a benzimidazole ring, benzindole ring, benzoindolenine ring, benzoxazole ring, benzothiazole ring, furopyrrole ring, imidazole ring, imidazoquinoxaline ring, indolenine ring, indolizine ring, isoxazole ring, naphthimidazole ring, naphthothiazole ring, naphthoxazole ring, oxazolocarbazole ring, oxazole ring, oxazolodibenzofuran ring, pyrrolopyridine ring, pyridine ring, quinoline ring, quinoxaline ring, thiazole ring, or naphthoimidazole ring.

8. The use of claim 6, wherein the near-infrared (NIR) absorbing heptamethine dye comprises a structure of:



or



,

or a rotational or conformational isomer or a salt thereof;

wherein

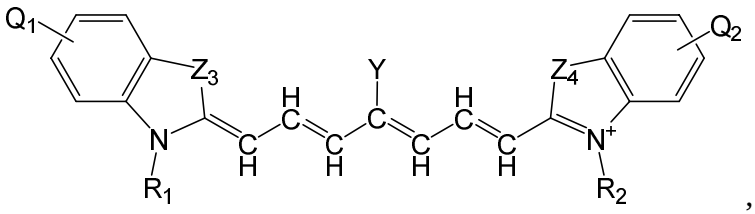
each of Z_3 and Z_4 is independently -$CR^{11}R^{12}$, -NR^{11}, -O-, -S- or -Se- (each of Z_3 and Z_4 is independently preferably --$CR^{11}R^{12}$, -NR^{11}, -O- or -S-, each of Z_3 and Z_4 is independently more preferably is -$CR^{11}R^{12}$, -O- or -S, each of Z_3 and Z_4 is independently further preferably is --$CR^{11}R^{12}$ or -O-, and each of Z_3 and Z_4 is independently most preferably -$CR^{11}R^{12}$);

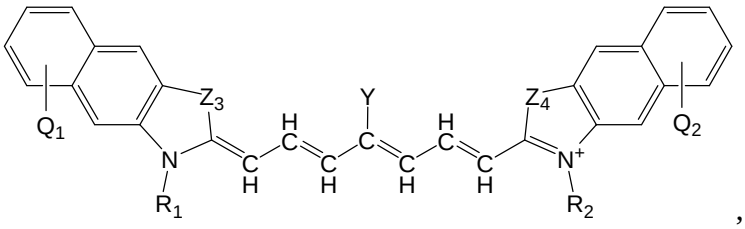
each of Z_5 and Z_6 is independently preferably phenyl, naphthyl, pyridinyl, quinolinyl, quinoxalinyl, N-alkyl-benzoindolenine, dibenzofuranyl, or dibenzothiophenyl,

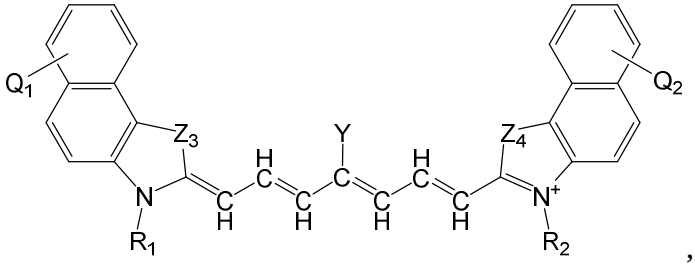
each of R^{11} and R^{12} is independently a $C_{1\text{-}6}$ alkyl, preferably methyl; and

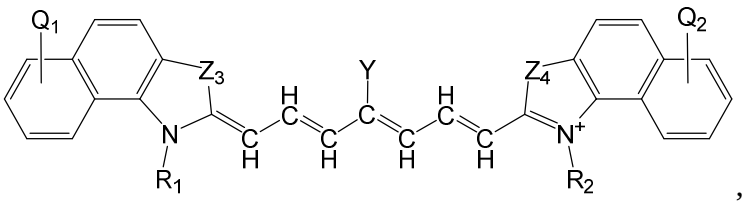
Q_1 and Q_2 are independently, preferably H, -COOH or a salt thereof, or -SO_3H or a salt thereof.

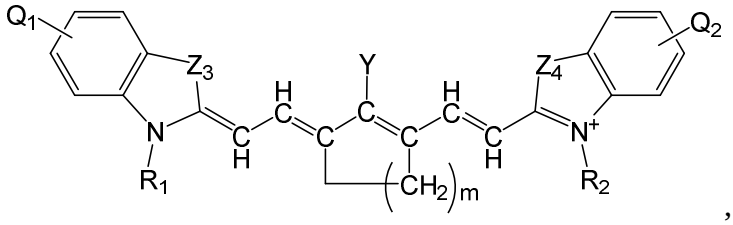
9. The use of claim 6, wherein the near-infrared (NIR) absorbing heptamethine dye comprises a structure of:

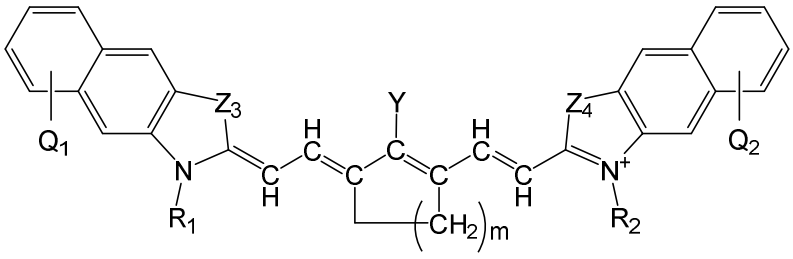

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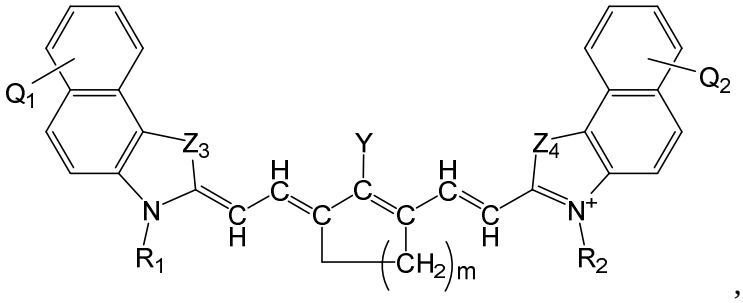

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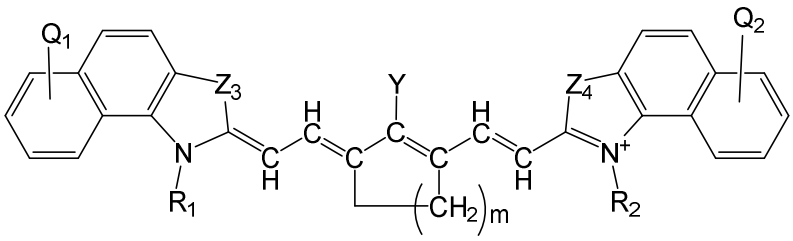

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, or


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or a rotational or conformational isomer or a salt thereof;

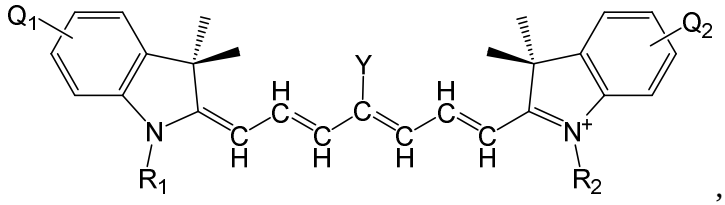
wherein each of Z_3 and Z_4 is independently -$CR^{11}R^{12}$, -NR^{11}, -O-, -S- or -Se- (each of Z_3 and Z_4 is independently preferably --$CR^{11}R^{12}$, -NR^{11}, -O- or -S-, each of Z_3 and Z_4 is independently more preferably is -$CR^{11}R^{12}$, -O- or -S, each of Z_3 and Z_4 is independently further preferably is --$CR^{11}R^{12}$ or -O-, and each of Z_3 and Z_4 is independently most preferably -$CR^{11}R^{12}$);

each of R^{11} and R^{12} is independently a $C_{1\text{-}6}$ alkyl, preferably methyl;

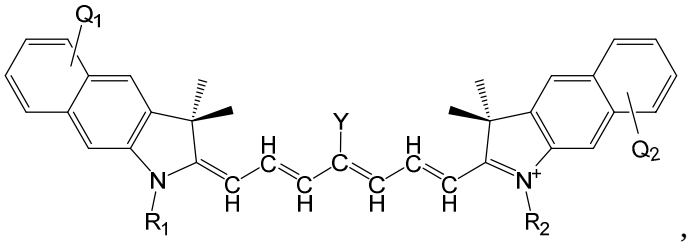
m = 1, 2, or 3; and

Q_1 and Q_2 are independently, preferably H, -COOH or a salt thereof, or -SO_3H or a salt thereof.

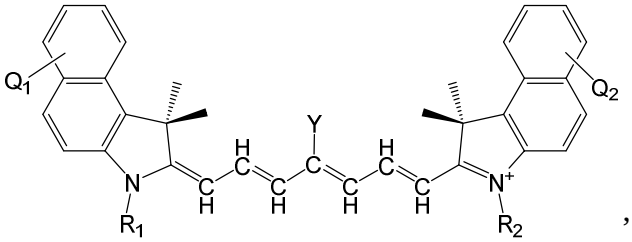
10. The use of claim 1, wherein the near-infrared (NIR) absorbing heptamethine dye comprises a structure of:



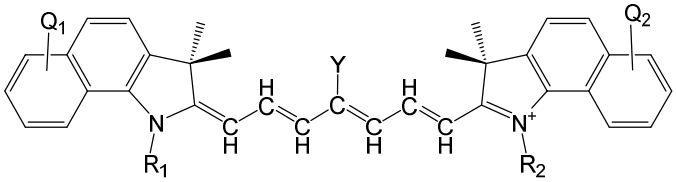
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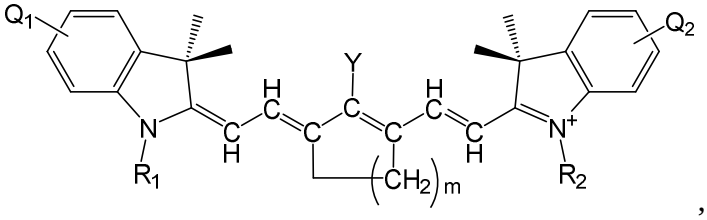
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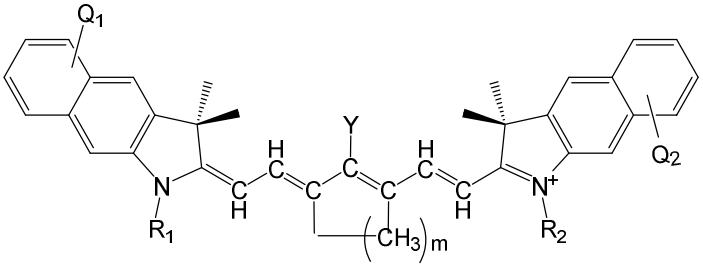
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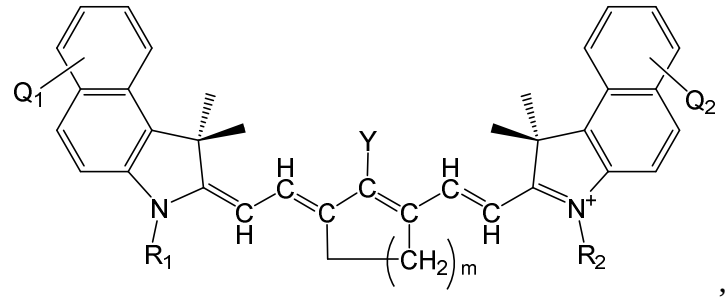
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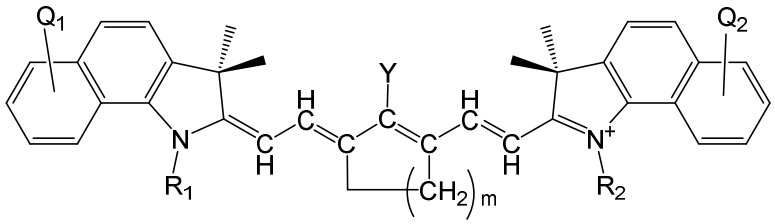
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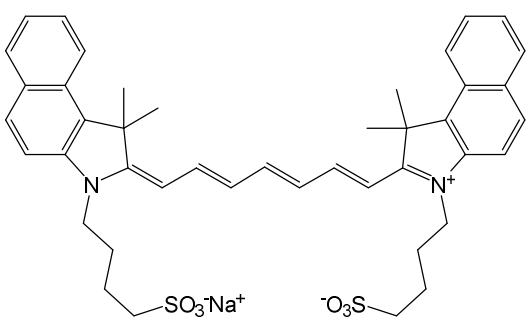
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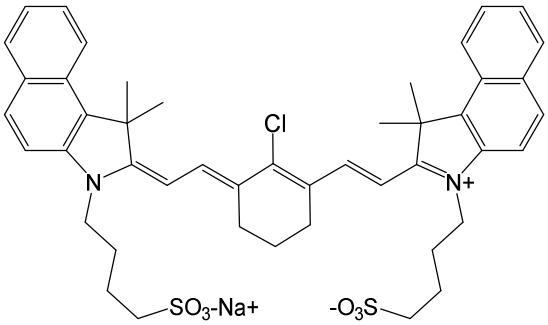
or a rotational or conformational isomer or a salt thereof;

where R_1 and R_2 are independently -(C_{1-12}alkyl)(SO_3)H or a salt thereof or -(C_{1-12}alkyl)COOH or a salt thereof.

11. The use of claim 1, wherein the near-infrared (NIR) absorbing heptamethine dye comprises a structure or rotational or conformation isomer of:



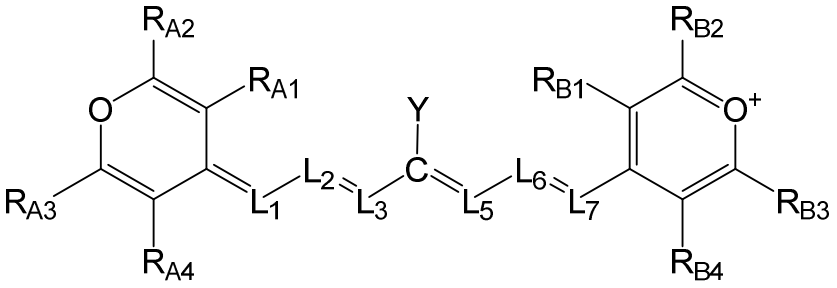
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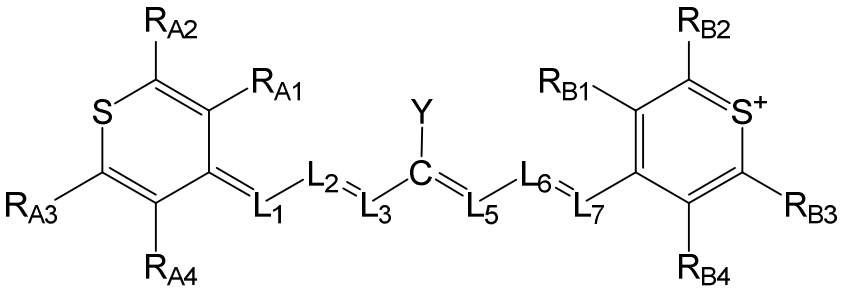
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or a rotational or conformational isomer or an alternative salt thereof.

12. The use of claim 1, wherein the near-infrared (NIR) absorbing heptamethine dye comprises a structure of:



or



,

respectively, or a rotational or conformational isomer or a salt thereof; wherein

L_1, L_2, L_3, L_5, L_6, and L_7 are substituted or unsubstituted methines, wherein the optional substitutents are independently C_{1-6} alkyl or C_{2-6} alkenyl; or L_1 and L_3, or L_3 and L_5, or L_5 and L_7 may be linked with C_{2-4} alkylene or C_{2-4} alkenylene substituents;

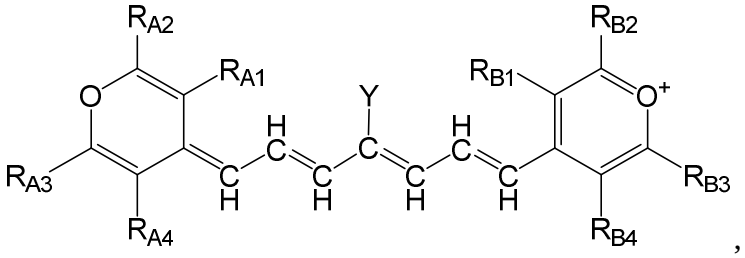
R_{A1}, R_{A2}, R_{A3}, R_{A4}, R_{B1}, R_{B2}, R_{B3}, and R_{B4} are each independently H, deutrium, or tritium, an C_{1-12} alkyl, $-[CH_2-CH_2-O-]_{1-6}$ R^{10}, C_{2-12} alkenyl, polyglycol optionally substituted 5- or 10-membered aryl or heteroaryl group, halo (fluoro, chloro, bromo, iodo), nitro, cyano, -(C_{0-12}alkyl) sulfonate or a salt thereof, -(C_{0-12}alkyl) sulfate or a salt thereof, -(C_{0-12}alkyl)phophate or a salt thereof, -(C_{0-12}alkyl)hydroxy, -(C_{0-12}alkyl)alkoxy, -(C_{0-12}alkyl)aryloxy, -(C_{0-12}alkyl)$NHSO_3R_{10}$ or a salt thereof, -(C_{0-12}alkyl)$COOR^{10}$ or a salt thereof, -(C_{0-12}alkyl)$CON(R^{10})_2$ or a salt thereof, -(C_{0-12}alkyl)$N(R^{10})_2$ or a salt thereof, -(C_{0-12}alkyl)borate;

n is independently 0, 1, 2, 3, or 4, preferably 2;

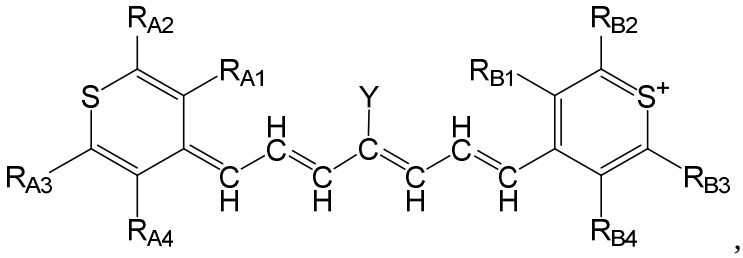
R^{10} is independently H or C_{1-6} alkyl; and

Y is H, or an optionally substituted amine, optionally substituted alkyl, optionally substituted alkoxy, optionally substituted aryl, optionally substituted heteroaryl, optionally substituted aryloxy, optionally substituted heteroaryloxy, halogen, or optionally substituted cationic nitrogen-containing heteroaryl moiety.

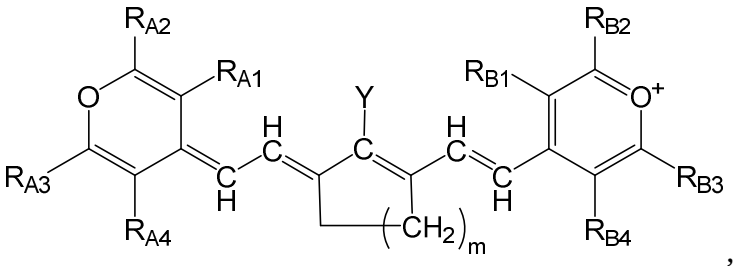
13. The use of claim 12, wherein the near-infrared (NIR) absorbing heptamethine dye comprises a structure of:



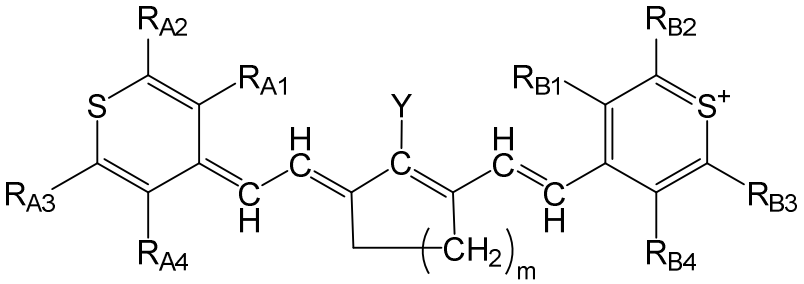
,



,



, or



,

or a rotational or conformational isomer or a salt thereof; where m is 1, 2, or 3.

14. The use of claim 12, wherein R_{A1}, R_{A4}, R_{B1}, and R_{B4} are H, or an isotope thereof, and R_{A2}, R_{A3}, R_{B2}, and R_{B3} are aryl, heteroaryl, or branched alkyl, preferably phenyl, pyridinyl, or tert-butyl.

15. The use of claim 6, wherein Y is H, or an optionally substituted amine, optionally substituted alkyl, optionally substituted alkoxy, optionally substituted aryl, optionally substituted heteroaryl, optionally substituted aryloxy, optionally substituted heteroaryloxy, or halogen.

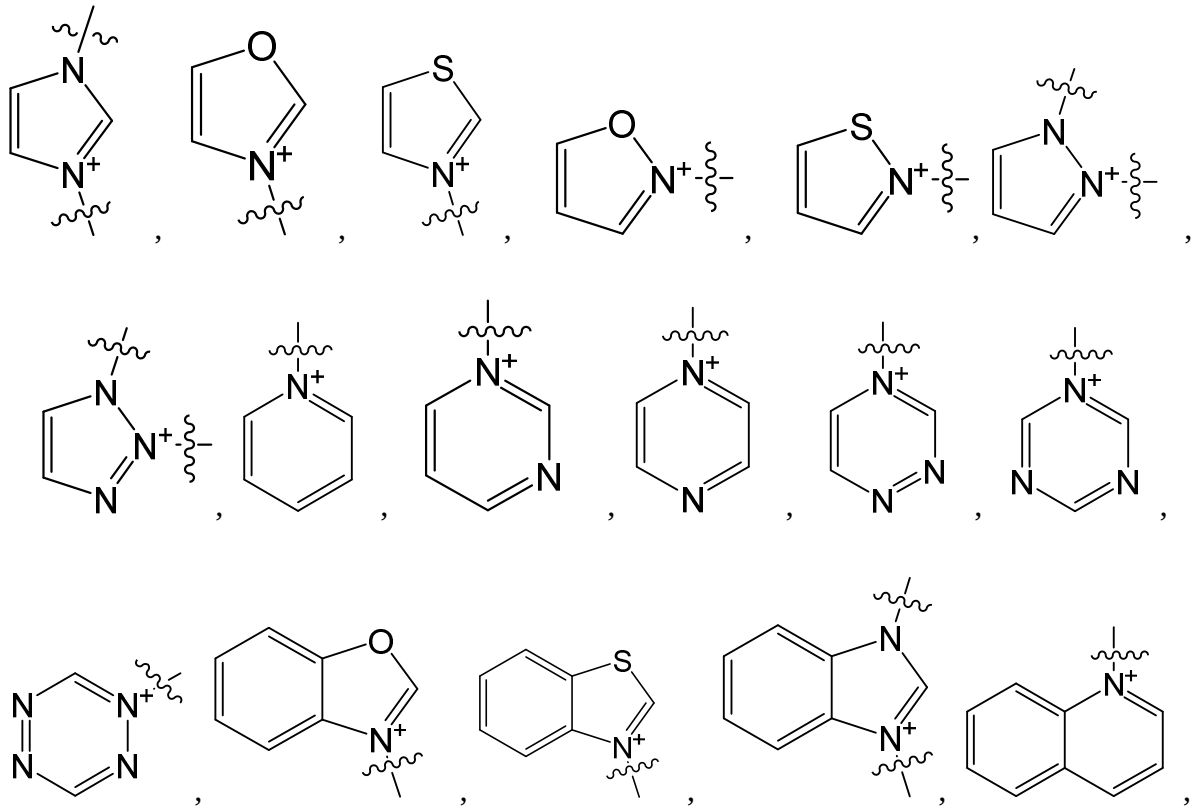
16. The use of claim 12, wherein Y is H, or an optionally substituted amine, optionally substituted alkyl, optionally substituted alkoxy, optionally substituted aryl, optionally

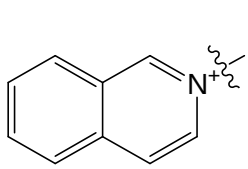
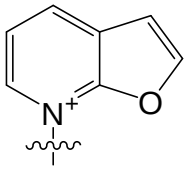
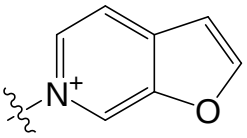
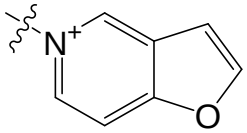
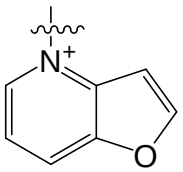
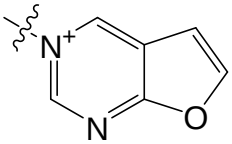
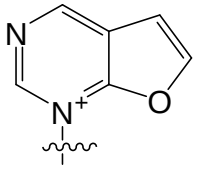
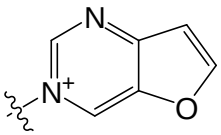
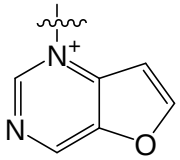
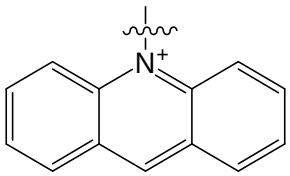
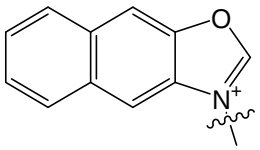
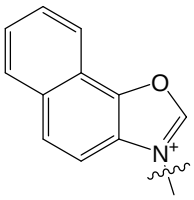
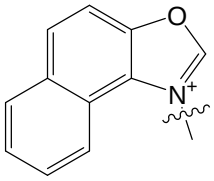
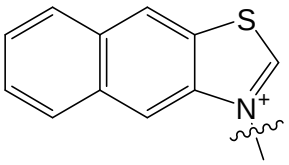
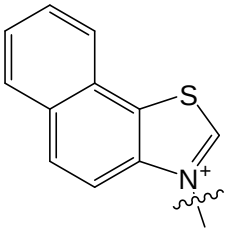
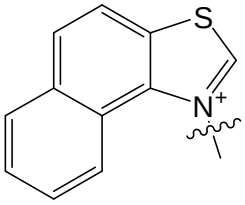
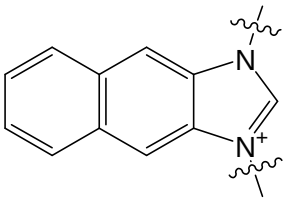
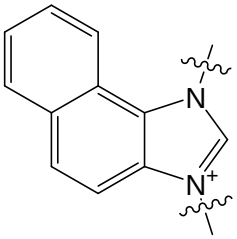
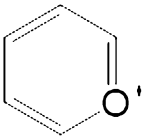
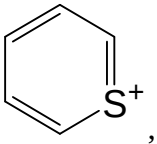
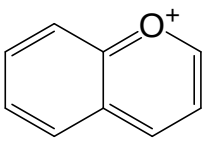
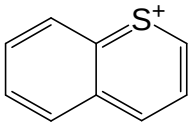
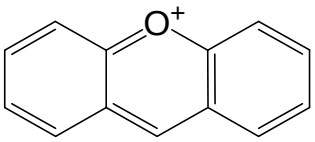
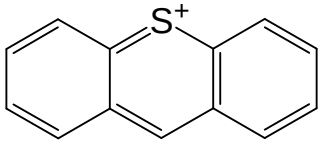
substituted heteroaryl, optionally substituted aryloxy, optionally substituted heteroaryloxy, or halogen.

17. The use of claim 6, wherein Y is an optionally substituted cationic heteroaryl ring moiety and the heptamethine linkage is orthogonally coupled to the optionally substituted cationic heteroaryl ring moiety, preferably comprising:

(a) an optionally substituted acridinium, benzoxazolium, benzothiazolium, imidazolium, isoxazolium, isoquinolinium, isothiazolium, naphthoimidazolium, naphthothiazolium, naphthoxazolium, oxazolium, pyrazinium, pyrazolium, pyridimium, pyridinium, quinolinium, tetrazinium, tetrazolium, thiazolium, triazinium, triazolium, benzopyrazinium, benzopyridimium, benzopyridinium, naphthopyrazinium, naphthopyridimium, benzopyridinium, benzotriazinium, naphthotriazinium moiety, pyrylium, chromenylium, xanthylium moiety, thiopyrylium, thiochromenylium, or thioxanthylium moiety; or

(b) an optionally substituted structure of:




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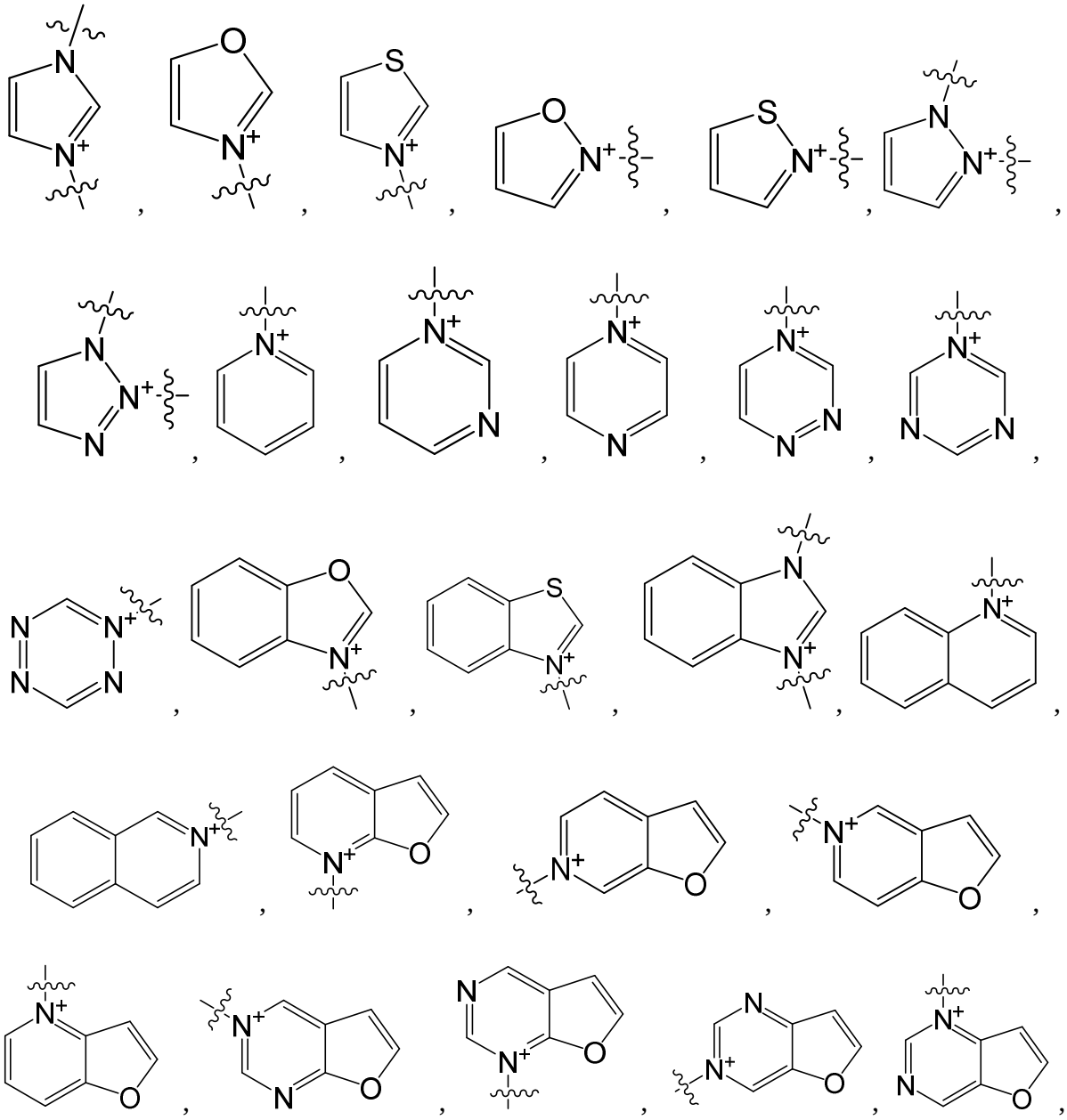
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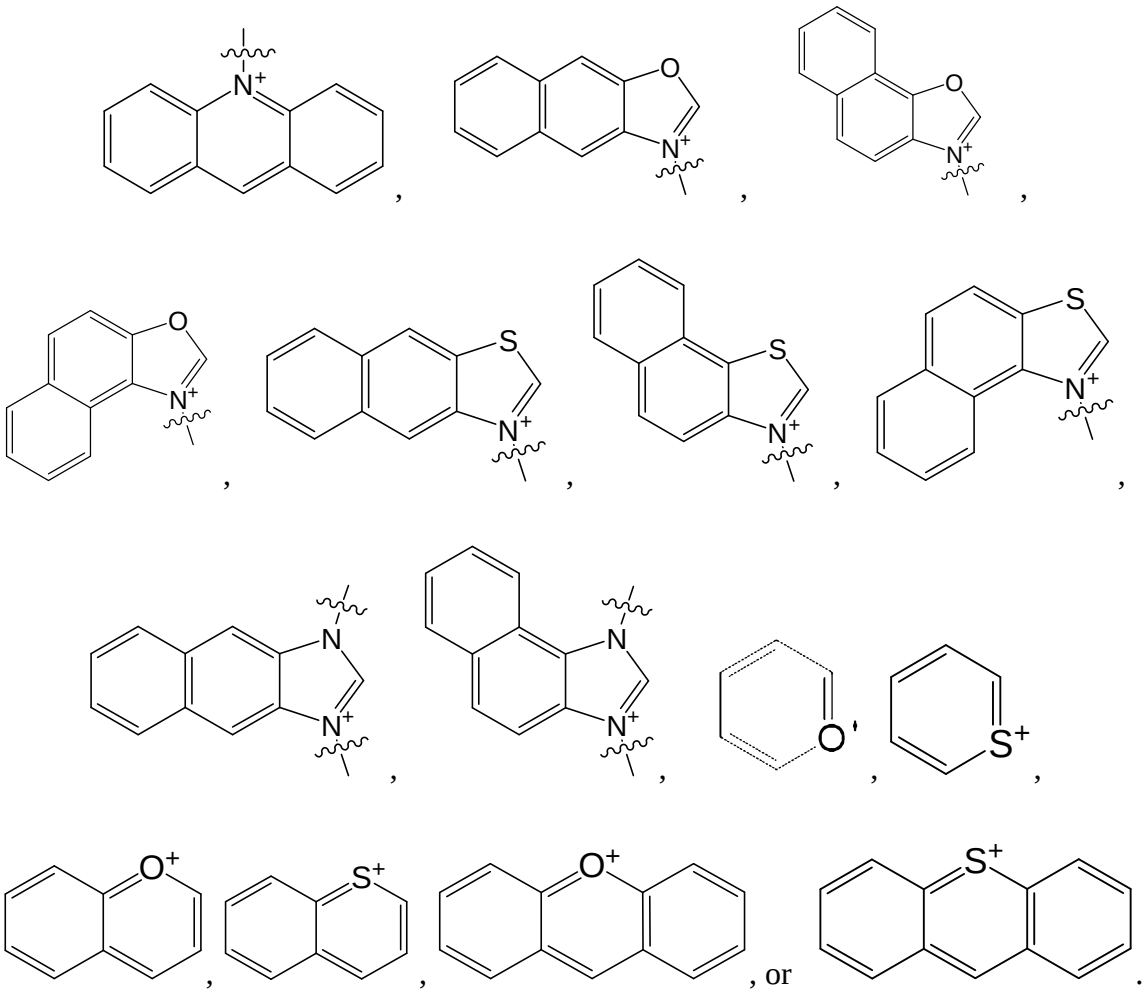
18. The use of claim 12, wherein Y is an optionally substituted cationic heteroaryl ring moiety and the heptamethine linkage is orthogonally coupled to the optionally substituted cationic heteroaryl ring moiety, preferably comprising:

(a) an optionally substituted acridinium, benzoxazolium, benzothiazolium, imidazolium, isoxazolium, isoquinolinium, isothiazolium, naphthoimidazolium,

naphthothiazolium, naphthoxazolium, oxazolium, pyrazinium, pyrazolium, pyridimium, pyridinium, quinolinium, tetrazinium, tetrazolium, thiazolium, triazinium, triazolium, benzopyrazinium, benzopyridimium, benzopyridinium, naphthopyrazinium, naphthopyridimium, benzopyridinium, benzotriazinium, naphthotriazinium moiety, pyrylium, chromenylium, xanthylium moiety, thiopyrylium, thiochromenylium, or thioxanthylium moiety; or

(b) an optionally substituted structure of:





19. The use of claim 1, wherein the near infrared light has a wavelength in a range of from 800 nm to 1400 nm.

20. The use of claim 1, wherein the near-infrared (NIR) photoactive direct treatment composition further comprises a biocompatible solvent that:

(a) is optically transparent in the UV-VIS and near-infrared range of the optical spectrum;

(b) provides an oxygen solubility greater than H_2O under comparable oxygen partial pressures, preferably a fluorinated or perfluorinated solvent;

(c) is or comprises a deuterated solvent, preferably D_2O;

(d) is oxygenated before or during the irradiation, preferably such that the dissolved oxygen is at a level of at least within 50% of the saturation limit of oxygen in the composition; or

(e) a combination of two or more of (a)-(d).

21. The use of claim 1, wherein the near-infrared (NIR) photoactive direct treatment composition further comprises an additive that enhances the solubility of the near-infrared dye, preferably a surfactant or alkali metal salt, preferably independently present at a level of 1 wt% to about 50 wt%, relative to the total weight of the direct treatment composition.

22. A composition comprising:

(a) a compound comprising a near-infrared (NIR) absorbing dye that generates singlet oxygen, when irradiated with light in the presence of oxygen at a wavelength in a range of from from 800 nm to 1400 nm; and

(b) one or more of

(i) an optically transparent, biocompatible solvent

(ii) a biocompatible solvent having an oxygen solubility that is greater than the oxygen solubility in H_2O under comparable oxygen partial pressures, preferably a fluorinated or perfluorinated solvent; or

(iii) a biocompatible solvent comprising an additive that provides a solubility of the near-infrared (NIR) absorbing dye in that solvent that is higher than the solubility of the near-infrared (NIR) absorbing dye in the absence of the additive, preferably a surfactant or alkali metal salt, preferably independently present at a level in a range from 100 ppm to 0.1 wt%, from 0.1 w% to 0.5 wt%, from 0.5 wt% to 1 wt%, from 1 wt% to 1.5 wt%, from 1.5 wt% to 2 wt%, from 2 wt% to 3 wt%, from 3 wt% to 4 wt%, from 4 wt% to 5 wt %, from 5 wt% to 7.5 wt%, from 7.5 wt% to 10 wt%, from 10 wt% to 15 wt%, from 15 wt% to 20 wt%, from 20 wt%, to 25 wt%, from 25 wt% to 30 wt%, from 30 wt% to 40 wt%, from 40 wt% to 50 wt%, or a range defined by two or more of the foregoing ranges, relative to the total weight of the direct treatment composition;

(iv) a biocompatible, deuterated solvent, preferably D_2O;

(v) a biocompatible solvent comprising oxygen dissolved at a level that is higher than the equilibrium concentration of oxygen when exposed to ambient atmospheric air; or

(vi) a combination of two or more of (i) to (v).