Claims

1. A method for manufacturing a catheter comprising a hydrophilic gel, said method comprising the steps of:

a. combining a polymeric photoinitiator of the general formula I:

$R_1(A_1)_r$-$(R_2(A_2)_m$-$O)_o$-$(R_3(A_3)_n$-$O)_p$-$R_4(A_4)_s$ (I)

wherein R_2 is -CH_2CH_2-, in which one or more H atoms may be replaced by A_2; and R_3 is -CH_2CH_2-, in which one or more H atoms may be replaced by A_3~~are independently at each occurrence identical or different, linear or branched alkylene or cycloalkylene groups; wherein R_2 and R_3 may be substituted with one or more substituents selected from CN; azides, esters; ethers; amides; halogen atoms; sulfones; sulfonic derivatives; NH_2 or $Nalk_2$, where alk is any C_1-C_8 straight chain alkyl group, C_3-C_8 branched or cyclic alkyl group~~;

R_1 is OH and R_4 is H;~~are independently at each occurrence identical or different, linear or branched alkyl or cycloalkyl groups or aryl groups or are independently at each occurrence selected from H, OH, CN, halogens, amines, amides, alcohols, ethers, thioethers, sulfones and derivatives thereof, sulfonic acid and derivatives thereof, sulfoxides and derivatives thereof, carbonates, isocyanates, nitrates, acrylates, polyethylenes, polyethylene oxides, polyvinyl pyrrolidones, polypropylenes, polyesters, polyamides, polyacrylates, polystyrenes, and polyurethanes; and when R_1 and R_4 are alkyl and aryl groups, they may be substituted with one or more substituents selected from CN; OH; azides; esters; ethers; amides; halogen atoms; sulfones; sulfonic derivatives; NH_2 or $Nalk_2$, where alk is any C_1-C_8 straight chain alkyl group, C_3-C_8 branched or cyclic alkyl group;~~

o and p are each a real number from 0-5000 provided that o + p > 0;

m=1 and n=0~~ are each a real number from 0-10,~~

~~provided that m + n > 0~~;

r and s are each ~~a real number from~~ 0~~-5~~; and

A_1, A_2, A_3 and A_4 are identical or different non-cleavable photoinitiator moieties~~;~~

linked to R_1, R_2, R_3, and R_4, respectively, via a spacer group selected from alkylene ethers;

with one or more gel-forming polymers and/or gel-forming monomers to form a matrix composition,

b. curing the matrix composition obtained in step a. by exposing it to UV radiation,

c. exposing the matrix composition to a swelling medium,

d. incorporating the hydrophilic gel/matrix composition into a catheter,

wherein steps b. and c. may take place in any order, provided that, if step d. is carried out first, step b. takes place before step c.

~~2. The method according to claim 1, wherein A_1, A_2, A_3 and A_4 are linked to R_1, R_2, R_3, and R_4, respectively, via a spacer group.~~

~~3. The method according to claim 2, wherein the spacer group is selected from the group consisting of alkylene, cycloalkylene, aryl, and alkylene ether groups.~~

~~4. The method according to any one of the preceding claims, wherein R_2= $-CH_2CH_2-$, in which one or more H atoms may be replaced by A_2.~~

~~5. The method according to any one of the preceding claims, wherein R_3= $-CH_2CH_2-$, in which one or more H atoms may be replaced by A_3.~~

~~6. The method according to any one of the preceding claims, wherein R_1 and R_4= $-CH_2CH_2-$, in which one or more H atoms may be replaced by A_1 or A_4, respectively.~~

~~7. The method according to any one of claims 1-5, wherein R_1=OH.~~

~~8. The method according to any one of claims 1-5 and 7, wherein R_4=H.~~

~~9. The method according to any one of the preceding claims, wherein A_1, A_2, A_3 and A_4 are identical or different photoinitiator moieties selected from the group consisting of benzoin ethers, phenyl hydroxyalkyl ketones, phenyl aminoalkyl ketones, benzophenones, thioxanthones, xanthones, acridones, anthraquinones, fluorenones, dibenzosuberones, benzils, benzil ketals, α-dialkoxy-acetophenones, α-hydroxy-alkyl-~~

~~phenones, α-amino-alkyl-phenones, acyl-phosphine-oxides, phenyl-ketocoumarins, silane, maleimides, and derivatives thereof.~~

~~10. The method according to claim 9, wherein A_1, A_2, A_3 and A_4 are identical or different photoinitiator moieties selected from the group consisting of 2-hydroxy-2-methyl-propiophenone, benzophenone, thioxanthone, benzil, anthraquionone, camphorquinone, benzoin ether, acylphosphine oxide, silane, and derivatives thereof.~~

~~11. The method according to any one of the preceding claims, wherein A_1, A_2, A_3 and A_4 are identical photoinitiator moieties.~~

~~12. The method according to any one of claims 1-10, wherein A_1, A_2, A_3 and A_4 are at least two different photoinitiator moieties.~~

~~13.~~2. The method according to claim 1~~2~~, wherein at least one of A_1, A_2, A_3 and A_4 is a benzophenone photoinitiator moiety.

~~14. The method according to claim 13, wherein at least A_2 and A_3 are benzophenone photoinitiator moieties.~~

~~15.~~3. The method according to any one of the preceding claims, wherein o and p are each from 0-3000, preferably 0-2000, provided that o + p > 0.

~~16. The method according to any one of the preceding claims, wherein m and n are each an integer of from 0-8, preferably 0-5, provided that m + n > 0.~~

~~17. The method according to any one of the preceding claims, wherein m = 1 and/or n = 1.~~

~~18.~~4. The method according to any one of the preceding claims, wherein m = 1, n = 0 and the ratio o:p is at least 1:1000, preferably at least 1:500.

~~19. The method according to any one of the preceding claims, wherein r and s are each from 0-4, preferably 0-2.~~

~~20.~~5. The method according to any one of the preceding claims, wherein the polymeric photoinitiator has a molecular weight between 5 kDa and 10,000 kDa, preferably between 10 kDa and 1,000 kDa, more preferably between 15 kDa and 500 kDa.

~~21. The method according to any one of claims 1-5 and 9-20, wherein R_1 and R_4 are selected from the group consisting of polyacrylates, polyethylene oxides, polyvinyl pyrrolidones, polyesters, polyamides and polyurethanes.~~

~~22. The method according to any one of claims 1-5 and 9-20, wherein R_1 and R_4 are each independently selected from C1-C25 linear alkyl, C3-C25 branched alkyl and C3-C25 cycloalkyl.~~

~~23.~~6. The method according to any of the preceding claims, wherein the gel-forming polymer is selected from the group consisting of polyacrylates, polyalkylethers, polyurethanes, polyethylene vinyl acetates, polyvinylpyrrolidone and co-polymers and blends thereof.

~~24.~~7. The method according to any of the preceding claims, wherein the gel-forming monomer is selected from the group consisting of acrylate monomers, N-vinylpyrrolidone, and epoxide monomers.

~~25.~~8. The method according to any of the preceding claims, wherein step b. takes place before step c.

~~26.~~9. A method for the manufacture of a gel precursor, said method comprising the steps of:

a. providing a polymeric photoinitiator of the general formula I:

$$R_1(A_1)_r\text{-}(R_2(A_2)_m\text{-}O)_o\text{-}(R_3(A_3)_n\text{-}O)_p\text{-}R_4(A_4)_s \quad (I)$$

wherein

R_2 is $-CH_2CH_2-$, in which one or more H atoms may be replaced by A_2;
R_3 is $-CH_2CH_2-$, in which one or more H atoms may be replaced by A_3;
R_1=OH;
R_4=H;

~~R_2 and R_3 are independently at each occurrence identical or different, linear or branched alkylene or cycloalkylene groups; wherein R_2 and R_3 may be substituted with one or more substituents selected from CN; azides, esters; ethers; amides; halogen atoms; sulfones; sulfonic derivatives; NH_2 or $Nalk_2$, where alk is any C_1-C_8 straight chain alkyl group, C_3-C_8 branched or cyclic alkyl group;~~

~~R_1 and R_4 are independently at each occurrence identical or different, linear or branched alkyl or cycloalkyl groups or aryl groups or are independently at each occurrence selected from H, OH, CN, halogens, amines, amides, alcohols, ethers, thioethers, sulfones and derivatives thereof, sulfonic acid and derivatives~~

~~thereof, sulfoxides and derivatives thereof, carbonates, isocyanates, nitrates, acrylates, polyethylenes, polyethylene oxides, polyvinyl pyrrolidones, polypropylenes, polyesters, polyamides, polyacrylates, polystyrenes, and polyurethanes; and when R_1 and R_4 are alkyl and aryl groups, they may be substituted with one or more substituents selected from CN; OH; azides; esters; ethers; amides; halogen atoms; sulfones; sulfonic derivatives; NH_2 or $Nalk_2$, where alk is any C_1-C_8 straight chain alkyl group, C_3-C_8 branched or cyclic alkyl group;~~

o and p are each a real number from 0-5000 provided that o + p > 0;

m = 1 and n=0~~m and n are each a real number from 0-10, provided that m + n > 0~~;

r and s are each 0~~r and s are each a real number from 0-5~~; and

A_1, A_2, A_3 and A_4 are identical or different non-cleavable photoinitiator moieties linked to R_1, R_2, R_3, and R_4, respectively, via a spacer group selected from alkylethers; and

b. exposing the polymeric photoinitiator from step a. to UV radiation,

thus providing a gel precursor.

~~27.~~10. A method for the manufacture of a hydrophilic gel, said method comprising steps a. and b. according to claim ~~26~~9, and the additional step of:

c. exposing the gel precursor to a swelling medium,

wherein steps b. and c. may take place in any order.

~~28.~~11. The method according to any of claims ~~26-27~~9-10, wherein the polymeric photoinitiator has the structure according to any one of claims 1-~~25~~.

~~29.~~12. The method according to any one of the preceding claims, where the swelling medium is selected from the group consisting of water, C1-C5 alcohols, glycerol and polyethylene glycol (PEG), preferably PEG-2000.

~~30.~~13. The method according to any one of the preceding claims, where the swelling medium comprises water, and the hydrophilic gel thus produced is a hydrogel.

~~31.~~14. The method according to any one of the preceding claims, wherein the matrix composition or polymeric photoinitiator is cured after exposure to the swelling medium.

~~32.~~15. The method according to any one of claims ~~27-31~~10-14, consisting of steps a. b. and c.

~~33. A gel precursor obtainable via the method of claim 26.~~

~~34. A hydrophilic gel obtainable via the method of any one of claims 27-32.~~

~~35. A medical device comprising the gel precursor of claim 33 or the hydrophilic gel of claim 34.~~

~~36. A catheter obtainable via the method of any of claims 1-25.~~

~~37. A catheter according to claim 36, wherein the hydrophilic gel is coated on at least a surface portion thereof.~~