CLAIMS

1. A method of coupling oligonucleotides to a polymer, comprising

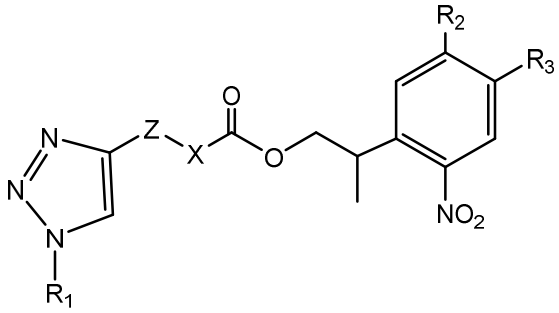
selectively irradiating first inactive moieties in a one or more first region of a polymer with light, while not irradiating second inactive moieties in a one or more second region of the polymer, to generate first active moieties in the one or more first region of the polymer;

coupling the first active moieties to first oligonucleotides;

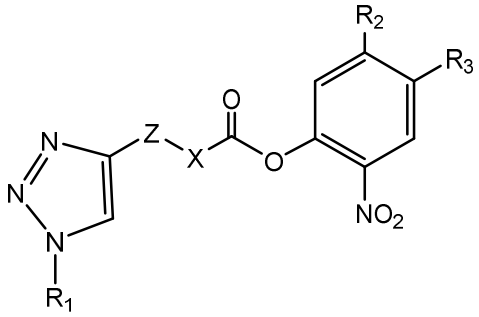
irradiating the second inactive moieties in the one or more second region of the polymer with light to generate second active moieties in the one or more second region of the polymer; and

coupling the second active moieties to second oligonucleotides,

wherein one or both of the first inactive moieties and the second inactive moieties comprise a protecting group wherein the protecting group is selected from an *o*-nitrobenzyl having a structure selected from

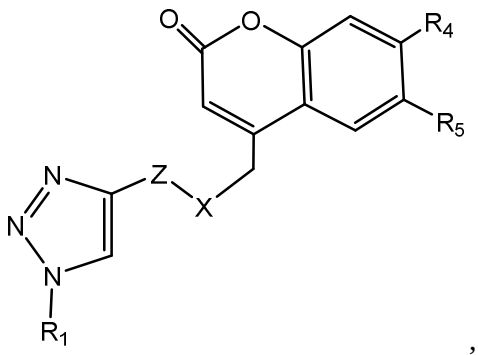


and



, wherein R_2 and R_3 are each independently selected from -H and -O-CH_3, and

a benzopyrone having a structure

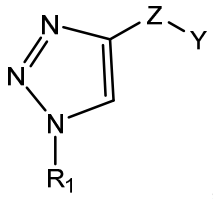


, wherein R_4 is selected from -H, -O-CH_3, and -N-$(CH_3)_2$, and R_5 is selected from -H and -Br,

Z comprises an alkane comprising one or more of -CH_2-, $(-CH_2)_m$, and $(-CH_2-O-)_n$, wherein m and n are independently an integer from 0 to 50, and

X is selected from -S and -N(H)- and R_1 is a linkage to a backbone of the polymer.

2. The method of claim 1, wherein one or both of the first active moieties and the second active moieties comprise a triazole:



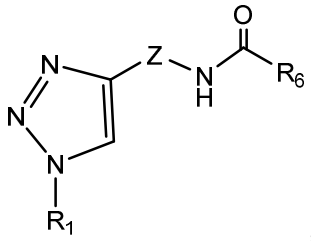
, wherein

Z comprises an alkane comprising one or more of -CH_2-, $(-CH_2)_m$, and $(-CH_2-O-)_n$, wherein m and n are independently an integer from 0 to 50, and

Y comprises a backbone reactive group selected from an amine and a thiol.

3. The method of claim 2, wherein the backbone reactive group comprises an amine.

4. The method of claim 3, wherein the first oligonucleotides or second oligonucleotides are coupled to oligonucleotide reactive groups and the oligonucleotide reactive groups are selected from N-hydroxysuccinimide esters, carboxylic acids, and *o*-acylisoureas that react with the amine to form a coupling having the structure:



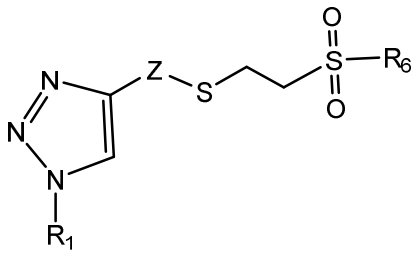
, wherein

Z comprises an alkane comprising one or more of -CH_2-, $(-CH_2)_m$, and $(-CH_2-O-)_n$, wherein m and n are independently an integer from 0 to 50, and

R_6 comprises the first oligonucleotides or the second oligonucleotides.

5. The method of claim 2, wherein the backbone reactive group comprises a thiol.

6. The method of claim 5, wherein the first oligonucleotides or second oligonucleotides are coupled to oligonucleotide reactive groups and the oligonucleotide reactive groups are vinylsulfones that react with the thiol to form a coupling having the structure:

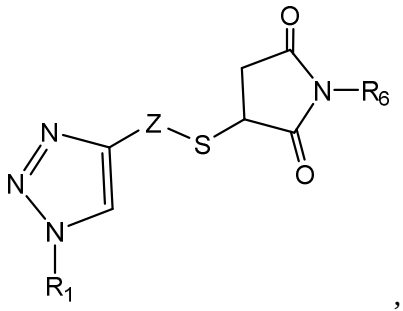


, wherein

Z comprises an alkane comprising one or more of $-CH_2-$, $(-CH_2)_m$, and $(-CH_2-O-)_n$, wherein m and n are independently an integer from 0 to 50, and

R_6 comprises the first oligonucleotides or the second oligonucleotides.

7. The method of claim 5, wherein the first oligonucleotides or second oligonucleotides are coupled to oligonucleotide reactive groups and the oligonucleotide reactive groups are maleimides that react with the thiol to form a coupling having the structure:

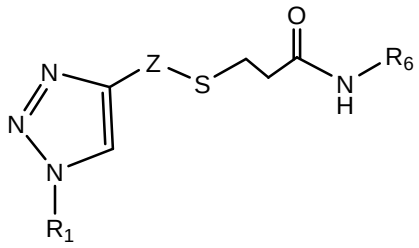


, wherein

Z comprises an alkane comprising one or more of $-CH_2-$, $(-CH_2)_m$, and $(-CH_2-O-)_n$, wherein m and n are independently an integer from 0 to 50, and

R_6 comprises the first oligonucleotides or the second oligonucleotides.

8. The method of claim 5, wherein the first oligonucleotides or second oligonucleotides are coupled to oligonucleotide reactive groups and the oligonucleotide reactive groups are acrylamides that react with the thiol to form a coupling having the structure:



, wherein

Z comprises an alkane comprising one or more of -CH_2-, (-CH_2)$_m$, and (-CH_2-O-)$_n$, wherein m and n are independently an integer from 0 to 50, and

R_6 comprises the first oligonucleotides or the second oligonucleotides.

9. The method of any one of claims 1 to 8, wherein:

the polymer contacts a plurality of surfaces on a top side of a substrate, and

one or both of the irradiating the first inactive moieties in the one or more first region of the polymer with light to generate the first active moieties in the one or more first region of the polymer and the irradiating the one or more second inactive moieties in the one or more second region of the polymer with light to generate the second active moieties in the one or more second region of the polymer comprises irradiating at least one surface of the plurality of surfaces.

10. The method of claim 9, wherein the plurality of surfaces comprise surfaces of nanowells and one or both of the irradiating the first inactive moieties in the one or more first region of the polymer with light and the irradiating the second inactive moieties in the one or more second region of the polymer with light comprises irradiating a bottom side of the substrate with ultraviolet radiation.

11. The method of claim 9, wherein the plurality of surfaces comprise surfaces of nanowells and a portion of the surfaces of the nanowells comprise a waveguide.

12. The method of claim 11, wherein one or both of the first inactive moieties in the one or more first region of the polymer and the second inactive moieties in the one or more second region of the polymer is irradiated by the waveguide.

13. The method of claim 11, wherein the substrate further comprises a material with low transparency to ultraviolet radiation.

14. The method of claim 9, wherein the plurality of surfaces comprise surfaces of multidepth nanowells and the multidepth nanowells comprise a deep portion and a shallow portion, wherein the one or more first region of the polymer contacts the deep portion and the one or more second region of the polymer contacts the shallow portion, and irradiating the first inactive moieties comprises:

irradiating a bottom side of the substrate and irradiating the second inactive moieties comprises:

irradiating the top side of the substrate.

15. The method of claim 9, wherein the plurality of surfaces comprise surfaces of multidepth nanowells and the multidepth nanowells comprising a deep well and a shallow well, wherein the one or more first region of the polymer contacts a bottom surface of the deep well and the one or more second region of the polymer contacts a bottom of the shallow well, and:

irradiating the first inactive moieties comprises irradiating a bottom side of the substrate and

irradiating the second inactive moieties comprises irradiating the top side of the substrate.

16. The method of claim 15, further comprising:

polishing the substrate to remove excess activated moieties.

17. The method of claim 15, wherein a portion of the substrate comprises metal oxide, wherein the metal oxide portion defines a height and width of the deep well and a height and width of the shallow well.

18. The method of claim 9, further comprising:

before the irradiating, patterning metal oxide on a portion of the plurality of surfaces, wherein based on the patterning, the plurality of surfaces comprise substrate surfaces and metal oxide surfaces; and

contacting the substrate surfaces with the one or more first region of the polymer and contacting the metal oxide surfaces with the one or more second region of the polymer.

19. The method of claim 18, wherein:

irradiating the first inactive moieties in the one or more first region of the polymer with light comprises irradiating a bottom side of the substrate; and

irradiating the second inactive moieties in the one or more second region of the polymer with light comprises irradiating the top side of the substrate.

20. The method of claim 19, further comprising:

polishing the substrate to remove excess active moieties.

21. The method of claim 11, further comprising:

patterning the waveguide onto the substrate before the irradiating.

22. The method of claim 11, wherein:

irradiating the first inactive moieties in the one or more first region of the polymer comprises irradiating with the waveguide, and

irradiating the second inactive moieties in the one or more second region of the polymer comprises irradiating the top side of the substrate.

23. The method of claim 22, further comprising:

polishing the substrate to remove excess inactive moieties.