CLAIMS

1. A method for providing an array, comprising:

(a) irradiating a substrate comprising an unmasked first region and a masked second region, whereby a photoresist in the first region is degraded to render oligonucleotide molecules in the first region available for hybridization and/or ligation, whereas oligonucleotide molecules in the second region are protected by a photoresist in the second region from hybridization and/or ligation; and

(b) attaching an oligonucleotide comprising a barcode sequence to oligonucleotide molecules in the first region via hybridization and/or ligation, wherein oligonucleotide molecules in the second region do not receive the barcode sequence,

thereby providing on the substrate an array comprising different oligonucleotide molecules in the first and second regions.

2. The method of claim 1, wherein oligonucleotide molecules on the substrate comprise one or more common sequences, optionally wherein the one or more common sequences comprise a common primer sequence, optionally wherein the common sequence is between about 10 and about 35 nucleotides in length.

3. The method of claim 1, wherein oligonucleotide molecules on the substrate are immobilized in a plurality of features, wherein the 3' terminal nucleotides of immobilized oligonucleotide molecules are distal to the substrate.

4. The method of claim 1, wherein oligonucleotide molecules on the substrate prior to the irradiating step are between about 4 and about 50 nucleotides in length.

5. The method of claim 1, wherein oligonucleotide molecules on the substrate comprise functional groups, optionally wherein the functional groups are amino or hydroxyl groups.

6. The method of claim 5, wherein the functional groups are not protected prior to the irradiating step, optionally wherein the functional groups are not protected by a photo-sensitive group, moiety, or molecule prior to the irradiating step.

7. The method of claim 1, further comprising a step of providing the substrate, wherein the first and second regions have the same photoresist, wherein the providing step comprises applying the photoresist to the substrate, thereby forming a photoresist layer on the substrate, optionally wherein the photoresist is applied via spin coating.

8. The method of claim 7, wherein oligonucleotide molecules on the substrate are embedded in the photoresist.

9. The method of claim 7, wherein oligonucleotide molecules on the substrate are embedded in an underlayer, and the photoresist forms a photoresist layer on top of the underlayer, optionally wherein the underlayer is a soluble polymer.

10. The method of any of claims 1-9, further comprising forming a pattern of oligonucleotide molecules on the substrate prior to applying the photoresist to the substrate, wherein the forming step comprises:

irradiating a substrate comprising a plurality of functional groups and a photoresist through a patterned mask, whereby the photoresist in a first region of the substrate is degraded, rendering functional groups in the first region available for reacting with functional groups in functionalized oligonucleotide molecules, whereas functional groups in a second region of the substrate are protected by the photoresist from reacting with functional groups in the oligonucleotide molecules; and

contacting the substrate with the functionalized oligonucleotide molecules, wherein the functionalized oligonucleotide molecules are coupled to functional groups in the first region but not to functional groups in the second region,

thereby forming a pattern of oligonucleotide molecules on the substrate.

11. The method of claim 10, further comprising rendering the reaction between the plurality of functional groups of the substrate and the functionalized oligonucleotide molecules irreversible.

12. The method of claim 10, wherein the irradiating and contacting steps are repeated in one or more cycles.

13. The method of any of claims 1-12, wherein the substrate is irradiated through a patterned mask.

14. The method of claim 13, comprising removing the patterned mask after the irradiating step,

optionally wherein the same patterned mask is re-used in a subsequent cycle of the irradiating and contacting steps, wherein the patterned mask is moved relative to the substrate; or

optionally wherein a different patterned mask is used in a subsequent cycle of the irradiating and contacting steps.

15. The method of any of claims 1-14, wherein the photoresist in the first region of the substrate is dissolved by a developer and removed.

16. The method of any of claims 1-15, wherein the barcode sequence is between about 4 and about 25 nucleotides in length.

17. The method of any of claims 1-16, wherein the oligonucleotide comprising the barcode sequence is hybridized to an oligonucleotide molecule in the first region.

18. The method of any of claims 1-17, wherein the oligonucleotide comprising the barcode sequence is ligated to an oligonucleotide molecule in the first region.

19. The method of any of claims 1-18, wherein the oligonucleotide comprising the barcode sequence is hybridized to a splint which is in turn hybridized to an oligonucleotide molecule in the first region.

20. The method of claim 19, further comprising ligating the oligonucleotide comprising the barcode sequence to the oligonucleotide molecule to generate a barcoded oligonucleotide molecule in the first region.

21. The method of any of claims 1-20, wherein the method comprises N cycles, N is an integer of 2 or greater, and one of the N cycles comprises the irradiating and the attaching steps.

22. The method of claim 21, wherein the barcode sequences received by oligonucleotide molecules in feature(s) on the substrate in cycle I and in feature(s) on in cycle J are different, wherein I and J are integers and $1 \leq I < J \leq N$.

23. The method of claim 21 or 22, wherein the photoresist is not removed prior to, during, or between one or more of the N cycles.

24. The method of any of claims 21-23, wherein the method comprises M rounds, M is an integer of 2 or greater, and each of the M rounds comprises one or more cycles.

25. The method of claim 24, wherein oligonucleotide molecules in a feature of the substrate receive a first barcode sequence in one of the cycles in round K, wherein K is an integer and $1 \leq K < M$, and oligonucleotide molecules in the feature comprising the first barcode sequence receive a second barcode sequence in one of the cycles in round $(K+1)$, thereby forming oligonucleotide molecules comprising the first and second barcode sequences.

26. The method of claim 25, wherein the diversity of barcode sequences in the oligonucleotides in a plurality of features on the substrate is N^M.

27. The method of claim 25 or 26, wherein the feature(s) is/are no more than 0.5 micron, no more than 1 micron, no more than 5 microns, no more than 10 microns, or no more than 15

microns, no more than 20 microns, no more than 25 microns, no more than 30 microns, or no more than 35 microns, no more than 40 microns, no more than 45 microns, or no more than 50 microns in diameter.

28. A method for providing an array, comprising:

(a) irradiating a substrate comprising an unmasked first region and a masked second region, whereby a photoresist in the first region is degraded to render oligonucleotide molecules in the first region available for hybridization and/or ligation, whereas oligonucleotide molecules in the second region are protected by a photoresist in the second region from hybridization and/or ligation; and

(b) contacting oligonucleotide molecules in the first region with a first splint and a first oligonucleotide comprising a first barcode sequence, wherein the first splint hybridizes to the first oligonucleotide and the oligonucleotide molecules in the first region,

wherein the first oligonucleotide is ligated to the oligonucleotide molecules in the first region, and the first oligonucleotide is not ligated to oligonucleotide molecules in the second region,

thereby providing on the substrate an array comprising different oligonucleotide molecules in the first and second regions.

29. A composition, comprising:

(i) a substrate comprising a first region and a second region,

(ii) hybridization complexes in the first region, wherein at least one of the hybridization complexes comprise an oligonucleotide molecule immobilized in the first region hybridized to a first splint, which comprises a sequence complementary to a first oligonucleotide comprising a first barcode sequence, and

(iii) oligonucleotide molecules immobilized in the second region and protected by a photoresist from hybridization and/or ligation.

30. A composition, comprising:

(i) a substrate comprising a first region and a second region,

(ii) hybridization complexes in the first region, wherein at least one of the hybridization complexes comprise an oligonucleotide molecule immobilized in the first region hybridized to a first splint, which comprises a sequence complementary to a first oligonucleotide comprising a first barcode sequence, wherein the hybridization complexes are protected by a first photoresist from hybridization and/or ligation, and

(iii) oligonucleotide molecules immobilized in the second region and protected by a second photoresist from hybridization and/or ligation.