extend generally orthogonally relative to substrate 12. In one embodiment, one or both of outer surfaces 16 and 18 comprise photoresist.

Referring to Fig. 2, a polymer 20 has been adsorbed to outer lateral surfaces 16 of spaced features 14. Further in one embodiment and as shown, polymer 20 is adsorbed to elevationally outer surfaces 18 of spaced features 14. In the context of this document, a polymer is an elongate molecule having a chain of chemically bonded monomers. By way of example, Fig. 3 diagrammatically depicts polymer 20 as having opposing sides 21 and 22, and opposing longitudinal ends 24 and 26. In one embodiment, the polymer is of known or predetermined chain length, with one of longitudinal ends 24, 26 adsorbing to outer lateral surfaces 16 whereby the adsorbed polymer projects lengthwise from such outer lateral surfaces with the polymer chain length defining a substantially uniform lateral thickness of the adsorbed polymer on the spaced features. Fig. 2 depicts one such example. Fig. 2 also depicts an example whereby lengthwise polymer projection is generally in an orthogonal or normal manner relative to major surfaces 16 and 18. Alternate embodiments where lengthwise projecting occurs may be used, for example at a different uniform angle to such major surfaces (Fig. 11) and/or in a coiled ensemble manner (Fig. 12) such as may occur with or analogous to grafted polymer brushes.

In one embodiment, polymer 20 between immediately adjacent spaced features 14 does not fill the space there-between, and thereby provides a void space 28 between immediately adjacent of spaced features 14. In one embodiment, all polymer that is adsorbed to outer lateral surfaces 16 consists essentially of a single composition polymer. The lateral width or thickness of polymer 20 adhered to outer surfaces 16, 18 may be determined by the molecular chain lengths of the polymer ($N^{*}b$), where N is degree of polymerization and b is a statistical segmental length, with the product thereof ranging from 1 nanometer to 10 nanometers in one example embodiment. Polymer 20 will likely adsorb in a manner in which sidewalls thereof contact or interact with immediately adjacent polymer molecules. Regardless, the adsorbing may be by one or both of physisorbing or chemisorbing.

existing or yet-to-be developed. Alternately as described above, the spaced features may comprise sites for subsequent chemical modification or selective chemical processing, for example staining for enhanced etch selectivity or for selective deposition of functional components in directed self-assembly.

Adsorption of polymer 20 to outer lateral surfaces 16, and in some embodiments also to elevational outer lateral surfaces 18, may be accomplished in the following manners, and by way of example only. Fig. 9 is used to explain one example with respect to a substrate fragment 50 which may be substrate 10 of Fig. 1. Fig. 9 depicts substrate 50 as comprising spaced features 14 comprising polymer 20 there-within. An example concentration range of polymer to be adsorbed within photoresist-comprising spaced features 14 is from 0.001% to 5.0% by weight. Polymer 20 may or may not be homogenously distributed within spaced features 14. Regardless, substrate 50 may be processed to move polymers 20 to adsorb at least to outer lateral surfaces 16 of spaced features 14. In one embodiment, the polymer is driven to project lengthwise from outer surfaces of the spaced features. Figs. 2, 12 and 13 depict such example embodiments wherein lengthwise projection is shown and relative to outer surfaces encompassed by both lateral surfaces 16 and elevational outer surfaces 18. Figs. 2, 12, and 13 also depict examples wherein no part of polymer 20 remains within solid features 14.

Alternate processing is contemplated, for example as shown in Fig. 10. In Fig. 10, one longitudinal end part of polymer 20 is miscible in and remains within solid features 14 and another longitudinal end part of polymer 20 opposite the one end is immiscible in features 14 and projects from the solid feature outer surfaces, for example in one embodiment from both lateral surfaces 16 and elevational surface 18. By way of example only, such may occur when using certain diblock copolymers received within features 14 where one of the diblocks is immiscible or phobic to the other material of spaced features 14 and the other diblock is neutral, philic, or miscible to the other material of features 14. Such may occur spontaneously or a suitable elevated temperature may be provided over a suitable time period to produce the structure of Fig. 10 from that of Fig. 9. An example range of heating is from about 100°C to about 300°C for anywhere from 5 seconds to 10 minutes. Then,

CLAIMS:

1. A method of forming a pattern on a substrate, comprising:

forming spaced features over a substrate;

adsorbing a polymer to outer lateral surfaces of the spaced features; and

removing either material of the spaced features selectively relative to the adsorbed polymer or material of the adsorbed polymer selectively relative to the spaced features to form a pattern on the substrate.

2. The method of claim 1 wherein the adsorbing comprises physisorbing.

3. The method of claim 1 wherein the adsorbing comprises chemisorbing.

4. The method of claim 1 wherein the polymer is of known chain length having opposing longitudinal ends, one of the longitudinal ends of the polymer adsorbing to the outer lateral surfaces whereby the adsorbed polymer projects lengthwise from the outer lateral surfaces with said chain length defining a substantially uniform lateral thickness of the adsorbed polymer on the spaced features.

5. The method of claim 1 wherein the polymer comprises one longitudinal end which is philic to composition of said outer lateral surfaces and adsorbs thereto.

6. The method of claim 1 wherein the polymer comprises one longitudinal end which is phobic to composition of said outer lateral surfaces.

7. The method of claim 6 wherein the one longitudinal end is hydrophobic.

8. The method of claim 1 wherein the polymer comprises one longitudinal end which is philic to composition of said outer lateral surfaces and adsorbs thereto, and comprises a longitudinal end opposite the one which is phobic to the composition of said outer lateral surfaces.

9. The method of claim 1 comprising removing material of the spaced features selectively relative to the adsorbed polymer.

10. The method of claim 1 comprising removing material of the adsorbed polymer selectively relative to the spaced features.

11. The method of claim 1 comprising adsorbing the polymer to elevationally outer surfaces of the spaced features.

12. The method of claim 1 comprising:

providing a void space between immediately adjacent of the spaced features having polymer adsorbed thereto;

depositing fill material to within the void space, over the spaced features, and over the adsorbed polymer; and

removing the fill material to expose the adsorbed polymer and leave fill material within the void space.

13. The method of claim 12 comprising removing the fill material to expose the spaced features and leave fill material within the void space.

14. The method of claim 13 comprising adsorbing the polymer to elevationally outer surfaces of the spaced features, the depositing forming the fill material over the polymer adsorbed to said elevationally outer surfaces, the removing including removal of the polymer adsorbed to said elevationally outer surfaces which exposes the spaced features.

15. The method of claim 12 wherein the fill material is of the same composition as that of elevational outer surfaces of the spaced features.

16. The method of claim 12 wherein the fill material is of different composition from that of elevational outer surfaces of the spaced features.

17. The method of claim 12 comprising removing material of the adsorbed polymer selectively relative to the spaced features and the fill material.

18. The method of claim 1 wherein the pattern is a mask pattern, and further comprising processing the substrate through the mask pattern.

19. The method of claim 1 wherein the pattern is formed to comprise sites for one of subsequent a) chemical modification, b) selective chemical processing, and c) selective deposition of functional components in directed self-assembly.

20. The method of claim 1 wherein the outer lateral surfaces comprise photoresist.

21. The method of claim 1 wherein the polymer is a copolymer.

22. The method of claim 21 wherein the polymer is a block copolymer.

23. The method of claim 21 wherein the polymer is a graft copolymer.

24. The method of claim 1 wherein the polymer is an oligomer.

25. The method of claim 1 wherein the polymer is an amphiphile.

26. The method of claim 1 wherein all polymer adsorbed to the outer lateral surfaces consists essentially of a single composition polymer.

27. A method of forming a pattern on a substrate, comprising:

forming spaced solid features over a substrate; and

expanding size of the spaced solid features without depositing separate solid material thereover.

28. The method of claim 27 comprising expanding the size of the spaced features without depositing liquid material thereover.

29. The method of claim 27 wherein the expanding results at least in part from depositing liquid material thereover.

30. The method of claim 27 wherein the spaced solid features comprise a polymer, the expanding comprising thermally driving the polymer within the solid features to project lengthwise from outer surfaces of the solid features.

31. The method of claim 30 wherein the outer surfaces are of an unexpanded portion of the features, one longitudinal end part of the polymer remaining within the unexpanded portion of the solid features and another longitudinal end part of the polymer opposite the one projecting from the outer surfaces of the solid features.

32. The method of claim 30 wherein the outer surfaces are of an unexpanded portion of the features, no part of the polymer remaining within the unexpanded portion of the solid features.

33. The method of claim 27 wherein the expanding is void of chemical reaction of the solid features with any matter thereover.

34. A method of forming a pattern on a substrate, comprising:

forming spaced features over a substrate, the features comprising a polymer there-within;

driving the polymer to project lengthwise from outer surfaces of the spaced features; and

removing either material of the spaced features selectively relative to the polymer or material of the polymer selectively relative to the spaced features to form a pattern on the substrate.

35. The method of claim 34 wherein the polymer is homogenously distributed within the spaced features at some time prior to the driving.

36. The method of claim 34 wherein one longitudinal end part of the polymer remains within the solid features and another longitudinal end part of the polymer opposite the one projects from the outer surfaces of the spaced features.

37. The method of claim 34 wherein no part of the polymer remains within the solid features.

38. A method of forming a pattern on a substrate, comprising:

forming spaced features over a substrate;

applying liquid to the spaced features to adsorb a polymer from the liquid onto outer lateral surfaces of the spaced features; and

removing either material of the spaced features selectively relative to the adsorbed polymer or material of the adsorbed polymer selectively relative to the spaced features to form a pattern on the substrate.

extend generally orthogonally relative to substrate 12. In one embodiment, one or both of outer surfaces 16 and 18 comprise photoresist.

Referring to Fig. 2, a polymer 20 has been adsorbed to outer lateral surfaces 16 of spaced features 14. Further in one embodiment and as shown, polymer 20 is adsorbed to elevationally outer surfaces 18 of spaced features 14. In the context of this document, a polymer is an elongate molecule having a chain of chemically bonded monomers. By way of example, Fig. 3 diagrammatically depicts polymer 20 as having opposing sides 21 and 22, and opposing longitudinal ends 24 and 26. In one embodiment, the polymer is of known or predetermined chain length, with one of longitudinal ends 24, 26 adsorbing to outer lateral surfaces 16 whereby the adsorbed polymer projects lengthwise from such outer lateral surfaces with the polymer chain length defining a substantially uniform lateral thickness of the adsorbed polymer on the spaced features. Fig. 2 depicts one such example. Fig. 2 also depicts an example whereby lengthwise polymer projection is generally in an orthogonal or normal manner relative to major surfaces 16 and 18. Alternate embodiments where lengthwise projecting occurs may be used, for example at a different uniform angle to such major surfaces (Fig. 12) and/or in a coiled ensemble manner (Fig. 13) such as may occur with or analogous to grafted polymer brushes.

In one embodiment, polymer 20 between immediately adjacent spaced features 14 does not fill the space there-between, and thereby provides a void space 28 between immediately adjacent of spaced features 14. In one embodiment, all polymer that is adsorbed to outer lateral surfaces 16 consists essentially of a single composition polymer. The lateral width or thickness of polymer 20 adhered to outer surfaces 16, 18 may be determined by the molecular chain lengths of the polymer ($N^{*}b$), where N is degree of polymerization and b is a statistical segmental length, with the product thereof ranging from 1 nanometer to 10 nanometers in one example embodiment. Polymer 20 will likely adsorb in a manner in which sidewalls thereof contact or interact with immediately adjacent polymer molecules. Regardless, the adsorbing may be by one or both of physisorbing or chemisorbing.

existing or yet-to-be developed. Alternately as described above, the spaced features may comprise sites for subsequent chemical modification or selective chemical processing, for example staining for enhanced etch selectivity or for selective deposition of functional components in directed self-assembly.

Adsorption of polymer 20 to outer lateral surfaces 16, and in some embodiments also to elevational outer lateral surfaces 18, may be accomplished in the following manners, and by way of example only. Fig. 9 is used to explain one example with respect to a substrate fragment 50 which may be substrate 10 of Fig. 1. Fig. 9 depicts substrate 50 as comprising spaced features 14 comprising polymer 20 there-within. An example concentration range of polymer to be adsorbed within photoresist-comprising spaced features 14 is from 0.001% to 5.0% by weight. Polymer 20 may or may not be homogenously distributed within spaced features 14. Regardless, substrate 50 may be processed to move polymer 20 to adsorb at least to outer lateral surfaces 16 of spaced features 14. In one embodiment, the polymer is driven to project lengthwise from outer surfaces of the spaced features. Figs. 2, 12 and 13 depict such example embodiments wherein lengthwise projection is shown and relative to outer surfaces encompassed by both lateral surfaces 16 and elevational outer surfaces 18. Figs. 2, 12, and 13 also depict examples wherein no part of polymer 20 remains within solid features 14.

Alternate processing is contemplated, for example as shown in Fig. 10. In Fig. 10, one longitudinal end part of polymer 20 is miscible in and remains within solid features 14 and another longitudinal end part of polymer 20 opposite the one end is immiscible in features 14 and projects from the solid feature outer surfaces, for example in one embodiment from both lateral surfaces 16 and elevational surface 18. By way of example only, such may occur when using certain diblock copolymers received within features 14 where one of the diblocks is immiscible or phobic to the other material of spaced features 14 and the other diblock is neutral, philic, or miscible to the other material of features 14. Such may occur spontaneously or a suitable elevated temperature may be provided over a suitable time period to produce the structure of Fig. 10 from that of Fig. 9. An example range of heating is from about 100°C to about 300°C for anywhere from 5 seconds to 10 minutes. Then,

The invention claimed is:

1. A method of forming a pattern on a substrate, comprising:

forming spaced features over a substrate;

adsorbing longitudinally elongated polymer molecules to opposing outer lateral surfaces of the spaced features, the polymer molecules individually having opposing longitudinal ends, one of the opposing ends of the individual polymer molecules being adsorbed to one of the opposing outer lateral surfaces whereby the individual polymer molecules project lengthwise from the outer lateral surface to which the individual polymer molecule is adsorbed; and

removing either material of the spaced features selectively relative to the adsorbed polymer molecules or material of the adsorbed polymer molecules selectively relative to the spaced features to form a pattern on the substrate.

2. The method of claim 1 wherein the adsorbing comprises physisorbing.

3. The method of claim 1 wherein the adsorbing comprises chemisorbing.

4. The method of claim 1 wherein the polymer molecules are of known uniform chain length defining a substantially uniform lateral thickness of the adsorbed polymer molecules on the spaced features.

5. The method of claim 1 wherein the one longitudinal end is philic to composition of the outer lateral surface to which the polymer molecule is adsorbed.

6. The method of claim 1 wherein the one longitudinal end is philic to composition of the outer lateral surface to which the polymer molecule is adsorbed, and the other of the opposing longitudinal ends is phobic to the composition of the outer lateral surface to which the polymer molecule is adsorbed.

7. The method of claim 1 comprising removing material of the spaced features selectively relative to the adsorbed polymer molecules.

8. The method of claim 1 comprising removing material of the adsorbed polymer molecules selectively relative to the spaced features.

9. The method of claim 1 comprising adsorbing the polymer molecules to elevationally outer surfaces of the spaced features.

10. The method of claim 1 wherein the pattern is a mask pattern, and further comprising processing the substrate through the mask pattern.

11. The method of claim 1 wherein the pattern is formed to comprise sites for one of subsequent a) chemical modification, b) selective chemical processing, and c) selective deposition of functional components in directed self-assembly.

12. The method of claim 1 wherein the outer lateral surfaces comprise photoresist.

13. The method of claim 1 wherein the polymer molecules form a polymer which is an oligomer.

14. The method of claim 1 wherein the polymer molecules form a polymer which is an amphiphile.

15. The method of claim 1 wherein all polymer molecules adsorbed to the outer lateral surfaces consists essentially of a single composition.

16. The method of claim 1 wherein the other of the opposing longitudinal ends is phobic to composition of the outer lateral surface to which the polymer molecule is adsorbed.

17. The method of claim 16 wherein the other longitudinal end is hydrophobic.

18. The method of claim 1 wherein the polymer molecules form a polymer which is a copolymer.

19. The method of claim 18 wherein the polymer is a block copolymer.

20. The method of claim 18 wherein the polymer is a graft copolymer.

21. The method of claim 1 wherein the lengthwise projection of the individual polymer molecules is at a uniform angle from the outer lateral surface to which the individual polymer molecule is adsorbed.

22. The method of claim 21 wherein the angle is orthogonal from the outer lateral surface to which the individual polymer molecule is adsorbed.

23. The method of claim 21 wherein the angle is other than orthogonal from the outer lateral surface to which the individual polymer molecule is adsorbed.

24. The method of claim 1 comprising: providing a void space between immediately adjacent of the spaced features having polymer molecules adsorbed thereto;

depositing fill material to within the void space, over the spaced features, and over the adsorbed polymer molecules; and

removing the fill material to expose the adsorbed polymer molecules and leave fill material within the void space.

25. The method of claim 24 wherein the fill material is of the same composition as that of elevational outer surfaces of the spaced features.

26. The method of claim 24 wherein the fill material is of different composition from that of elevational outer surfaces of the spaced features.

27. The method of claim 24 comprising removing material of the adsorbed polymer molecules selectively relative to the spaced features and the fill material.

28. The method of claim 24 wherein the fill material as-deposited completely fills the void space.

29. The method of claim 24 comprising removing the fill material to expose the spaced features and leave fill material within the void space.

30. The method of claim 29 comprising adsorbing the polymer molecules to elevationally outer surfaces of the spaced features, the depositing forming the fill material over the polymer molecules adsorbed to said elevationally outer surfaces, the removing including removal of the polymer molecules adsorbed to said elevationally outer surfaces which exposes the spaced features.

31. A method of forming a pattern on a substrate, comprising:

forming spaced solid features over a substrate; and

expanding size of the spaced solid features without depositing separate solid material thereover, without depositing liquid material thereover, and without heating the substrate during said expanding; and

after the expanding, removing laterally central portions of the expanded spaced solid features selectively relative to laterally outermost portions of the expanded spaced solid features.

32. The method of claim 31 wherein the expanding is void of chemical reaction of the solid features with any matter thereover.

33. The method of claim 31 wherein the pattern is a mask pattern, and further comprising processing the substrate through the mask pattern.

34. The method of claim 31 wherein the pattern is formed to comprise sites for one of subsequent a) chemical modification and b) selective deposition of functional components in directed self-assembly.

35. A method of forming a pattern on a substrate, comprising:

forming spaced solid features over a substrate, the spaced solid features comprising outer surfaces and comprising longitudinally elongated polymer molecules; and

expanding size of the spaced solid features, the expanding comprising thermally driving the polymer molecules within the solid features to project lengthwise from the outer surfaces of the solid features.

36. The method of claim 35 wherein the outer surfaces are of an unexpanded portion of the features, one longitudinal end part of individual of the polymer molecules remaining within the unexpanded portion of the solid features and another longitudinal end part of individual of the polymer molecules opposite the one projecting from the outer surfaces of the solid features.

37. The method of claim 35 wherein the outer surfaces are of an unexpanded portion of the features, no part of the polymer molecules remaining within the unexpanded portion of the solid features.

38. A method of forming a pattern on a substrate, comprising:

forming spaced features over a substrate, the features comprising longitudinally elongated polymer molecules there-within;

driving the polymer molecules to project lengthwise from outer surfaces of the spaced features; and removing either material of the spaced features selectively relative to the polymer molecules or material of the polymer molecules selectively relative to the spaced features to form a pattern on the substrate.

39. The method of claim 38 wherein the polymer molecules are homogenously distributed within the spaced features at some time prior to the driving.

40. The method of claim 38 wherein one longitudinal end part of individual of the polymer molecules remains within the spaced features and another longitudinal end part of individual of the polymer molecules opposite the one projects from the outer surfaces of the spaced features.

41. The method of claim 38 wherein no part of the polymer molecules remain within the spaced features.

42. A method of forming a pattern on a substrate, comprising:

forming spaced features over a substrate; applying liquid to the spaced features to adsorb longitudinally elongated polymer molecules from within the liquid onto outer lateral surfaces of the spaced features, the polymer molecules projecting lengthwise from the outer lateral surfaces of the spaced features; and

removing either material of the spaced features selectively relative to the adsorbed polymer molecules or material of the adsorbed polymer molecules selectively relative to the spaced features to form a pattern on the substrate.

43. The method of claim 42 wherein the spaced features are void of the polymer molecules prior to the applying.

44. The method of claim 42 wherein the applying comprises a rinse with deionized water containing the polymer molecules.

45. A method of forming a pattern on a substrate, comprising:

forming spaced solid features over a substrate, the spaced solid features comprising outer surfaces and comprising longitudinally elongated polymer molecules; and

expanding size of the spaced solid features, the expanding comprising driving the polymer molecules within the solid features to project lengthwise from the outer surfaces of the solid features.

46. The method of claim 45 wherein the outer surfaces are of an unexpanded portion of the features, one longitudinal end part of individual of the polymer molecules remaining within the unexpanded portion of the solid features and another longitudinal end part of individual of the polymer molecules opposite the one projecting from the outer surfaces of the solid features.

47. The method of claim 45 wherein the outer surfaces are of an unexpanded portion of the features, no part of the polymer molecules remaining within the unexpanded portion of the solid features.