What is claimed is:

1. A method, comprising:

forming a patterned hydrophobic polymer layer on a cross-linked epoxy polyhedral oligomeric silsesquioxane (POSS) resin film on a support surface, thereby exposing discrete areas of the cross-linked epoxy POSS resin film;

applying a polymer coating to form an attached coating portion on the exposed discrete areas and an unattached coating portion on the patterned hydrophobic layer; and

washing the unattached coating portion off of the patterned hydrophobic layer.

2. The method as defined in claim 1, further comprising forming the cross-linked epoxy POSS resin film on the support surface, the forming involving:

mixing an epoxy silane and at least one epoxy POSS monomeric unit in the presence of a photoacid generator and optionally a sensitizer to form a resin precursor;

depositing the resin precursor on the support surface; and

curing the resin precursor to form the cross-linked epoxy POSS resin film.

3. The method as defined in claim 2, wherein the mixing and depositing occur at the same time.

4. The method as defined in claim 2 or claim 3, wherein the epoxy silane is an epoxy silane bound to the support surface.

5. The method as defined in claim 1, further comprising forming the cross-linked epoxy POSS resin film on the support surface, the forming involving:

mixing an epoxy silane, epoxycyclohexylalkyl POSS, and glycidyl POSS in the presence of a photoacid generator and optionally a sensitizer to form a resin precursor;

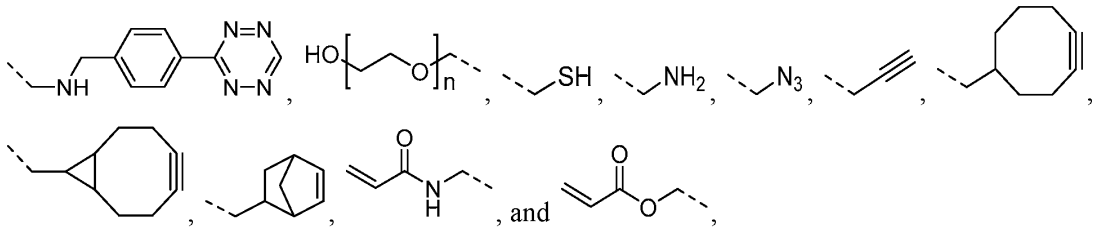
depositing the resin precursor on the support surface; and

curing the resin precursor to form the cross-linked epoxy POSS resin film.

6. The method as defined in any of the preceding claims, wherein prior to forming the patterned hydrophobic polymer layer, the method further comprises:

exposing the cross-linked epoxy POSS resin film to plasma ashing or a chemical treatment to introduce -OH groups to the cross-linked epoxy POSS resin film; and

attaching functional groups to at least some of the -OH groups, the functional groups being selected from the group consisting of:



, and

wherein n ranges from 1 to 20, and

wherein --- represents an alkylsilane, a poly(ethylene glycol)-silane, an alkyl, or a polyethylene glycol chain.

7. The method as defined in claim 1, further comprising forming the cross-linked epoxy POSS resin film on the support surface, the forming involving:

mixing, in the presence of a photoacid generator and optionally a sensitizer, an epoxy silane, epoxycyclohexylalkyl POSS, glycidyl POSS, and a POSS core including at least one epoxy functional group and a non-epoxy functional group to form a resin precursor;

depositing the resin precursor on the support surface; and

curing the resin precursor to form the cross-linked epoxy POSS resin film.

8. The method as defined in any of the preceding claims, wherein washing involves sonication in water.

9. The method as defined in any of the preceding claims, wherein forming the patterned hydrophobic polymer layer involves:

i) depositing a hydrophobic polymer on the cross-linked epoxy POSS resin film; and patterning the deposited hydrophobic polymer using at least one of nanoimprint lithography and photolithography; or

ii) depositing the hydrophobic polymer in a pattern on the cross-linked epoxy POSS resin film using at least one of inkjet printing and microcontact printing.

10. The method as defined in any of the preceding claims, further comprising grafting an amplification primer to the attached coating portion.

11. An array, comprising:

a support;

a cross-linked epoxy polyhedral oligomeric silsesquioxane (POSS) resin film on a surface of the support;

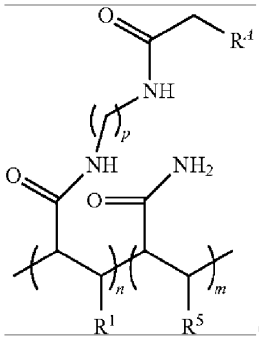
a patterned hydrophobic polymer layer on the cross-linked epoxy POSS resin film, the patterned hydrophobic polymer layer defining exposed discrete areas of the cross-linked epoxy POSS resin film; and

a polymer coating attached to the exposed discrete areas.

12. The array as defined in claim 11, wherein:

the patterned hydrophobic layer is selected from the group consisting of a fluoropolymer, a negative tone photoresist, and a polysiloxane; and

the polymer coating includes a recurring unit of Formula (I):



(I)

wherein:

R^1 is H or optionally substituted alkyl;

R^A is selected from the group consisting of azido, optionally substituted amino, optionally substituted alkenyl, optionally substituted hydrazone, optionally substituted hydrazine,

carboxyl, hydroxy, optionally substituted tetrazole, optionally substituted tetrazine, nitrile oxide, nitrone, and thiol;

R^5 is selected from the group consisting of H and optionally substituted alkyl;

each of the $-(CH_2)_p-$ can be optionally substituted;

p is an integer in the range of 1 to 50;

n is an integer in the range of 1 to 50,000; and

m is an integer in the range of 1 to 100,000.

13. The array as defined in claim 11 or claim 12, further comprising an amplification primer grafted to the polymer coating.

14. A method, comprising:

forming a patterned hydrophobic polymer layer on a modified epoxy polyhedral oligomeric silsesquioxane (POSS) resin film on a support surface, thereby exposing discrete areas of the modified epoxy POSS resin film, wherein the modified epoxy POSS resin film includes a polymer growth initiation site; and

growing a polymer brush from the polymer growth initiation site in the exposed discrete areas.

15. The method as defined in claim 14, further comprising forming the cross-linked epoxy POSS resin film on the support surface, the forming involving:

mixing an epoxy silane, at least one epoxy POSS monomeric unit, and an epoxy-functionalized polymerization agent or controlled radical polymerization (CRP) agent in the presence of a photoacid generator and optionally a sensitizer to form a resin precursor;

depositing the resin precursor on the support surface; and

curing the resin precursor to form the modified epoxy POSS resin film.

16. The method as defined in claim 15, wherein the mixing and depositing occur at the same time.

17. The method as defined in claim 15 or claim 16, wherein the epoxy silane is an epoxy silane bound to the support surface.

18. The method as defined in claim 14, further comprising forming the modified epoxy POSS resin film, the forming involving:

mixing an epoxy silane, epoxycyclohexylalkyl POSS, glycidyl POSS, and an epoxy-functionalized polymerization agent or controlled radical polymerization (CRP) agent in the presence of a photoacid generator and optionally a sensitizer to form a resin precursor;

depositing the resin precursor on the support surface; and

curing the resin precursor to form the modified epoxy POSS resin film.

19. The method as defined in any one of claims 15 to 18, wherein the epoxy-functionalized CRP agent is an epoxy-functionalized reversible addition-fragmentation chain transfer (RAFT) agent or an epoxy-functionalized atom transfer radical polymerization (ATRP) initiator.

20. The method as defined in claim 18, wherein a molar or mass ratio of epoxycyclohexylalkyl POSS and glycidyl POSS to epoxy-functionalized CRP agent ranges from about 1:1 to about 9:1.

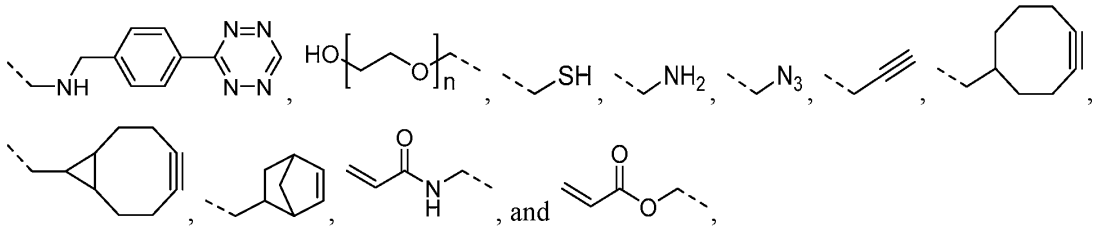
21. The method as defined in any one of claims 14 to 20, further comprising:

exposing the epoxy POSS resin film to plasma ashing or a chemical treatment to introduce -OH groups to the epoxy POSS resin film;

attaching functional groups to at least some of the -OH groups; and

attaching controlled radical polymerization (CRP) agents to at least some of the functional groups.

22. The method as defined in claim 21, wherein the functional groups are selected from the group consisting of:



, and

wherein n ranges from 1 to 20, and

wherein --- represents an alkylsilane, a poly(ethylene glycol)-silane, an alkyl, or a polyethylene glycol chain.

23. The method as defined in claim 14, further comprising forming the modified epoxy POSS resin film, the forming involving:

mixing, in the presence of a photoacid generator and optionally a sensitizer, an epoxy silane, epoxycyclohexylalkyl POSS, glycidyl POSS, and a POSS core including at least one epoxy functional group and a controlled radical polymerization (CRP) agent functional group to form a resin precursor;

depositing the resin precursor on the support surface; and

curing the resin precursor to form the modified epoxy POSS resin film.

24. The method as defined in claim 14, further comprising forming the modified epoxy POSS resin film, the forming involving:

mixing, in the presence of a photoacid generator and optionally a sensitizer, an epoxy silane, epoxycyclohexylalkyl POSS, glycidyl POSS, and a POSS core including at least one epoxy functional group and a non-epoxy functional group to form a resin precursor;

depositing the resin precursor on the support surface;

curing the resin precursor to form an initially modified epoxy POSS resin film; and

introducing a controlled radical polymerization (CRP) agent functional group to the initially modified epoxy POSS resin film to form the modified epoxy POSS resin film.

25. The method as defined in any one of claims 14 to 24, wherein forming the patterned hydrophobic polymer layer involves:

i) depositing a hydrophobic polymer on the modified epoxy POSS resin film; and patterning the deposited hydrophobic polymer using at least one of nanoimprint lithography and photolithography; or

ii) depositing the hydrophobic polymer in a pattern on the modified epoxy POSS resin film using patterned printing.

26. An array, comprising:

a support;

a modified epoxy polyhedral oligomeric silsesquioxane (POSS) resin film on a surface of the support, the modified epoxy POSS resin film including a polymer growth initiation site;

a patterned hydrophobic polymer layer on the modified epoxy POSS resin film, the patterned hydrophobic polymer layer defining exposed discrete areas of the modified epoxy POSS resin film; and

a polymer brush attached to the polymer growth initiation site in the exposed discrete areas.

27. The array as defined in claim 26, further comprising an amplification primer grafted to the polymer brush.

28. A composition, comprising:

a support; and

a cross-linked epoxy POSS resin film on a surface of the support.

29. The composition as defined in claim 28, wherein the cross-linked epoxy POSS resin film is patterned to define discrete areas and interstitial regions, wherein the discrete areas are optionally wells.

30. The composition as defined in claim 28 or claim 29, wherein the cross-linked epoxy POSS resin film comprises monomeric units derived from a support-bound epoxy silane, an epoxycyclohexylalkyl POSS, and a glycidyl POSS.

31. The composition as defined in any one of claims 28 to 30, further comprising a hydrophobic polymer layer on the resin film.

32. The composition of claim 29 or claim 30, further comprising a hydrophobic polymer layer on the resin film, wherein the hydrophobic polymer layer is patterned to expose the resin film in the discrete areas or wells while remaining on the resin film in the interstitial areas of the resin film between the discrete areas or wells.

33. The composition as defined in any one of claims 29 to 32, further comprising a polymer coating attached to the discrete areas of the cross-linked epoxy POSS resin film.

34. A method, comprising:

forming a cross-linked epoxy POSS resin film on a support surface, where the forming involves mixing a support-bound epoxy silane with one or more epoxy-functionalized POSS reagents in the presence of a photoacid generator and optionally a sensitizer to form a support-bound resin precursor; and

curing the resin precursor to form a support-bound cross-linked epoxy POSS resin film.

35. The method as defined in claim 34, wherein the one or more epoxy-functionalized POSS reagents comprise an epoxycyclohexylalkyl POSS and a glycidyl POSS.

36. The method as defined in claim 34 or claim 35, further comprising reacting the support surface with an epoxy silane to form the support-bound epoxy silane.

37. The method as defined any one of claims 34 to 36, further comprising forming a hydrophobic polymer layer on the cross-linked, support-bound epoxy POSS resin film on the support surface, wherein the hydrophobic polymer layer is patterned to expose the resin film in discrete areas or wells while remaining on the resin film in interstitial areas of the resin film between the discrete areas or wells.