

What is claimed is:

1. A self-assembling monolayer (SAM) forming composition for forming a SAM on a surface, the composition comprising
 - a SAM precursor having a backbone with a surface reactive group X,
 - wherein the backbone contains no Si-C bonds and is selected from the group consisting of a Si-C bond-free polysilane and a trisilylamine,
 - wherein the surface reactive group X is selected from:
 - a halide (Cl, Br, I);
 - a cyanate, an isocyanate or a thiocyanate group;
 - an amino group $-NR^1R^2$, wherein R^1 is selected from H, a linear, branched or cyclic C_1 - C_{10} alkyl or alkenyl group or an alkyl silyl group; R^2 is selected from a linear, branched or cyclic C_2 - C_{10} alkyl or alkenyl group, or an alkyl silyl group; or R^1 and R^2 are bridged so that NR^1R^2 forms a cyclic ligand, provided that the cyclic ligand includes heteroatoms S, N or O;
 - an amidinate group $-R^3-N-C(R^4)=N-R^5$, wherein R^3 and R^5 are each independently selected from a C_1 to C_{10} linear or branched alkyl or a trialkylsilyl; and R^4 is selected from H, a C_1 to C_{10} linear or branched alkyl; or
 - a thiol $-SH$ group, a phosphonic acid or a carboxylic acid.
2. The composition of claim 1, wherein X is a dialkylamino group $-NR^1R^2$, wherein R^1 is H, a C_2 to C_5 alkyl, and R^2 is a C_1 to C_5 alkyl, provided that if $R^1=H$, R^2 is a C_3 to C_5 alkyl, and if R^1 not H, R^1 and R^2 are preferably identical.
3. The composition of claim 1, wherein X is an amidinate group $-NR^3-C(R^4)=N-R^5$ wherein R^3 and R^5 are each independently selected from Et, *n*Pr, *i*Pr, *n*Bu, *t*Bu, *s*Bu, *i*Bu; and R^4 is H or Me.
4. The composition of any one of claims 1, 2 and 3, wherein the SAM precursor having the Si-C-free polysilane backbone is selected from
 - $X-(SiH_2)_n-SiH_3$, wherein $n=1$ to 3,
 - $X-(Si_nH_{2n})$, wherein Si_nH_{2n} refers to a cyclic hydridosilane backbone with $n=5, 6, 7$,
 - $X-(SiH(SiH_3)_2)$, or
 - $X-SiH_2-Si(SiH_3)_3$.

5. The composition of any one of claims 1, 2 and 3, wherein the SAM precursor having the Si-C-free polysilane backbone is selected from $\text{NiPr}_2\text{-(SiH}_2\text{)-SiH}_3$, $\text{NnBu}_2\text{-(SiH}_2\text{)-SiH}_3$, $\text{NtBu}_2\text{-(SiH}_2\text{)-SiH}_3$, $\text{NsBu}_2\text{-(SiH}_2\text{)-SiH}_3$, $\text{N/Bu}_2\text{-(SiH}_2\text{)-SiH}_3$, $\text{NPen}_2\text{-(SiH}_2\text{)-SiH}_3$, $\text{NnPr}_2\text{-(SiH}_2\text{)}_2\text{-SiH}_3$, $\text{NiPr}_2\text{-(SiH}_2\text{)}_2\text{-SiH}_3$, $\text{NnBu}_2\text{-(SiH}_2\text{)}_2\text{-SiH}_3$, $\text{NtBu}_2\text{-(SiH}_2\text{)}_2\text{-SiH}_3$, $\text{NsBu}_2\text{-(SiH}_2\text{)}_2\text{-SiH}_3$, $\text{N/Bu}_2\text{-(SiH}_2\text{)}_2\text{-SiH}_3$, $\text{NnPen}_2\text{-(SiH}_2\text{)}_2\text{-SiH}_3$, $\text{NHTBu-(SiH}_2\text{)}_2\text{-SiH}_3$, $\text{NHPen-(SiH}_2\text{)}_2\text{-SiH}_3$, $\text{NHsBu-(SiH}_2\text{)}_2\text{-SiH}_3$, $\text{NHtBu-(SiH}_2\text{)}_2\text{-SiH}_3$, $\text{NnPr}_2\text{-(SiH}_2\text{)}_3\text{-SiH}_3$, $\text{NiPr}_2\text{-(SiH}_2\text{)}_3\text{-SiH}_3$, $\text{NnBu}_2\text{-(SiH}_2\text{)}_3\text{-SiH}_3$, $\text{NtBu}_2\text{-(SiH}_2\text{)}_3\text{-SiH}_3$, $\text{NsBu}_2\text{-(SiH}_2\text{)}_3\text{-SiH}_3$, $\text{N/Bu}_2\text{-(SiH}_2\text{)}_3\text{-SiH}_3$, $\text{NnPen}_2\text{-(SiH}_2\text{)}_3\text{-SiH}_3$, $\text{NEt}_2\text{-(SiH(SiH}_3\text{)}_2)$, $\text{NiPr}_2\text{-(SiH(SiH}_3\text{)}_2)$, $\text{NnPr}_2\text{-(SiH(SiH}_3\text{)}_2)$, $\text{N/Bu}_2\text{-(SiH(SiH}_3\text{)}_2)$, $\text{NtBu}_2\text{-(SiH(SiH}_3\text{)}_2)$, $\text{NnBu}_2\text{-(SiH(SiH}_3\text{)}_2)$, $\text{NsBu}_2\text{-(SiH(SiH}_3\text{)}_2)$, $\text{NnPen}_2\text{-(SiH(SiH}_3\text{)}_2)$, $\text{NHtBu-(SiH(SiH}_3\text{)}_2)$, $\text{NHnBu-(SiH(SiH}_3\text{)}_2)$, $\text{NH/Bu-(SiH(SiH}_3\text{)}_2)$, or $\text{NHPen-(SiH(SiH}_3\text{)}_2)$.

6. The composition of any one of claims 1, 2 and 3, wherein the Si-C-free polysilane backbone of the SAM precursor is selected from $\text{--SiH}_2\text{--SiH}_3$ or $\text{--SiH}_2\text{--SiH}_2\text{--SiH}_3$.

7. The composition of any one of claims 1, 2 and 3, wherein the SAM precursor having the trisilylamine backbone has a general formula



wherein $n=1$ or 2 ; R is selected from H or a C_1 to C_6 branched or linear alkyl; X' has the same definition as X and is independent from X .

8. The composition of claim 7, wherein the SAM precursor having the trisilylamine backbone is $\text{XH}_2\text{Si-N(SiH}_3\text{)}_n\text{(SiX'H}_3\text{)}_{2-n}$ or $\text{XR}_2\text{Si-N(SiR}_3\text{)}_2$.

9. The composition of claim 7, wherein the SAM precursor having the trisilylamine backbone contains more than one N(–Si)_3 units and has backbones of $\text{(Si)}_2\text{N–Si–N(Si)Si–X}$ or $\text{X–Si–N(Si)–Si–N(Si)Si–X}$.

10. A process of forming a self-assembling monolayer (SAM) on a surface, the process comprising the steps of

preparing the surface for exposure of the surface to a SAM forming composition, the composition comprising a SAM precursor having a backbone with a surface reactive group X ,

wherein the backbone contains no Si-C bonds and is selected from the group consisting of a Si-C-free polysilane and a trisilylamine,

wherein the surface reactive group X is selected from:

- a halide (Cl, Br, I);
- a cyanate, an isocyanate or a thiocyanate group;
- an amino group $-NR^1R^2$, wherein R^1 is selected from H, a linear, branched or cyclic C_1 - C_{10} alkyl or alkenyl group or an alkyl silyl group; R^2 is selected from a linear, branched or cyclic C_2 - C_{10} alkyl or alkenyl group, or an alkyl silyl group; or R^1 and R^2 are bridged so that NR^1R^2 forms a cyclic ligand, provided that the cyclic ligand includes heteroatoms S, N or O;
- an amidinate group $-R^3-N-C(R^4)=N-R^5$, wherein R^3 and R^5 are each independently selected from a C_1 to C_{10} linear or branched alkyl or a trialkylsilyl; and R^4 is selected from H, a C_1 to C_{10} linear or branched alkyl; or
- a thiol $-SH$, a phosphonic acid or a carboxylic acid;

exposing of the surface to the SAM forming composition; and
forming the SAM on the surface.

11. The process of claim 10, wherein the SAM forming composition is a solution and the exposure of the surface to the SAM forming composition is a liquid phase exposure.

12. The process of claim 10, wherein the SAM forming composition is a vapor and the exposure of the surface to the SAM forming composition is a gas phase exposure.

13. A film-forming process, the process comprising the steps of:
preparing a surface on a substrate for exposure of the surface to a self-assembling monolayer (SAM) forming composition, the composition comprising a SAM precursor having a backbone with a surface reactive group X,

wherein the backbone contains no Si-C bonds and is selected from the group consisting of a Si-C-free polysilane and a trisilylamine,

wherein the surface reactive group X is selected from:

- a halide (Cl, Br, I);
- a cyanate, an isocyanate or a thiocyanate group;
- an amino group $-NR^1R^2$, wherein R^1 is selected from H, a linear, branched or cyclic C_1 - C_{10} alkyl or alkenyl group or an alkyl silyl group; R^2 is selected from a linear, branched or cyclic C_2 - C_{10} alkyl or alkenyl group, or an alkyl silyl group; or R^1 and R^2 are bridged so that NR^1R^2 forms a cyclic ligand, provided that the cyclic ligand includes heteroatoms S, N or O;

- an amidinate group $-R^3-N-C(R^4)=N-R^5$, wherein R^3 and R^5 are each independently selected from a C_1 to C_{10} linear or branched alkyl or a trialkylsilyl; and R^4 is selected from H, a C_1 to C_{10} linear or branched alkyl; or
 - a thiol $-SH$, a phosphonic acid or a carboxylic acid;
- exposing of the surface to the SAM forming composition;
- forming the SAM on the surface through a liquid or gas phase exposure; and
- growing a film on top of the SAM through a wet or dry deposition process using a film-forming precursor.
14. The process of claim 13, wherein the film-forming precursor is a metal or metalloid precursor, and wherein the backbone of the SAM precursor acts as a reducing agent to the metal or metalloid precursor.
15. The process of claim 14, wherein the metal precursor is selected from a main group element, or a transition metal element selected from Ti, Ta, W, Mo, Nb, or V, a fluoride, a chloride, a bromide, an iodide, an oxychloride, an oxybromide, an oxyfluoride and combinations thereof.
16. The process of claim 14, wherein the metal precursor is selected from WF_6 , WOF_4 , $WOCl_4$, WCl_6 , WCl_5 , $MoCl_5$, $MoOCl_4$, MoO_2Cl_2 , $TiCl_4$, $TiBr_4$, TiI_4 , $TaCl_5$, $AlCl_3$, VCl_4 , $NbCl_5$, BCl_3 , BBr_3 , $GeCl_4$, $GeBr_4$ or $GeCl_2$, $GeBr_2$ and combinations thereof.
17. The process of claim 13, wherein the step of preparing the surface is to prepare a silicon, silicon germanium or germanium film surface formed by a CVD process.
18. The process of any one of claims 13 to 17, wherein the Si film is a porous Silicon deposited by PECVD.
19. The process of any one of claims 13 to 17, wherein the wet deposition process is a spin-on-deposition process and the dry deposition process is an ALD or CVD process.
20. The process of any one of claims 13 to 17, wherein the substrate is a powder or a nano-powder.