What is claimed is:

1. A method for depositing an etch resistant polymer layer ~~plasma etching a silicon-containing layer~~ on a substrate, the method comprising,

introducing a vapor of a compound into a reaction chamber containing the ~~silicon-containing layer on a~~ substrate, the compound having a formula selected from the group consisting of:

~~R^1-SH~~

~~R^2-S-R^3~~

~~$C_2F_4S_2$~~ ($C_2F_4S_2$ (CAS 1717-50-6), F_3CSH (CAS 1493-15-8), F_3C-CF_2-SH (CAS 1540-78-9), F_3C-CH_2-SH (CAS 1544-53-2), CHF_2-CF_2-SH (812-10-2), CF_3-CF_2-CH_2-SH (CAS 677-57-6), F_3C-CH(SH)-CF_3 (CAS 1540-06-3), F_3C-S-CF_3 (CAS 371-78-8), F_3C-S-CHF_2 (CAS 371-72-2), F_3C-CF_2-S-CF_2-CF_3 (CAS 155953-22-3), F_3C-CF_2-CF_2-S-CF_2-CF_2-CF_3 (CAS 356-63-8), c(-S-CF_2-CF_2-CHF-CF_2-) (CAS 1035804-79-5), c(-S-CF_2-CHF-CHF-CF_2-) (CAS 30835-84-8), c(-S-CF_2-CF_2-CF_2-CF_2-CF_2-) (CAS 24345-52-6), c(-S-CFH-CF_2-CF_2-CFH-)(2 R, 5 R) (CAS 1507363-75-8), c(-S-CFH-CF_2-CF_2-CFH-)(2 R, 5 S) (CAS 1507363-76-9), and c(-S-CFH-CF_2-CF_2-CH_2-) (CAS 1507363-77-0); and

plasma activating the compound to form the etch-resistant polymer layer on the substrate.

~~Wherein R^1, R^2, and R^3 is each independently a saturated C1 to C4 alkyl or fluoroalkyl group and R^2 and R^3 may be joined to form a 5 or 6 member S-containing ring;~~

~~introducing an inert gas into the chamber;~~

~~generating a plasma to produce an activated vapor from the vapor; and~~

~~removing volatile by-product from the chamber, wherein the activated vapor selectively reacts with the silicon-containing layer to form the volatile by-product.~~

2. The method of claim 1, wherein the compound is $C_2F_4S_2$ (CAS 1717-50-6).

~~3. The method of claim 1, wherein the compound has the formula R^1-SH.~~

~~4~~3. The method of claim ~~3~~1, wherein the compound is selected from the group consisting of F_3CSH (CAS 1493-15-8), F_3C-CF_2-SH (CAS 1540-78-9),

F_3C-CH_2-SH (CAS 1544-53-2), CHF_2-CF_2-SH (812-10-2), CF_3-CF_2-CH_2-SH (CAS 677-57-6), and F_3C-CH(SH)-CF_3 (CAS 1540-06-3).

~~5. The method of claim 1, wherein the compound has the formula R^2-S-R^3.~~

~~6~~4. The method of claim ~~5~~1, wherein the compound is selected from the group consisting of F_3C-S-CF_3 (CAS 371-78-8), F_3C-S-CHF_2 (CAS 371-72-2), F_3C-CF_2-S-CF_2-CF_3 (CAS 155953-22-3), and F_3C-CF_2-CF_2-S-CF_2-CF_2-CF_3 (CAS 356-63-8).

~~7. The method of claim 5, wherein R^2 and R^3 are joined to form a 5 to 6 member S-containing ring.~~

~~8~~5. The method of claim ~~7~~1, wherein the compound is selected from the group consisting of c(-S-CF_2-CF_2-CHF-CF_2-) (CAS 1035804-79-5), c(-S-CF_2-CHF-CHF-CF_2-) (CAS 30835-84-8), c(-S-CF_2-CF_2-CF_2-CF_2-CF_2-) (CAS 24345-52-6), c(-S-CFH-CF_2-CF_2-CFH-)(2 R, 5 R) (CAS 1507363-75-8), c(-S-CFH-CF_2-CF_2-CFH-)(2 R, 5 S) (CAS 1507363-76-9), and c(-S-CFH-CF_2-CF_2-CH_2-) (CAS 1507363-77-0).

~~9~~6. The method of ~~any one of claims 1 to 8~~claim 1, wherein the etch-resistant polymer layer forms a S-containing polymer passivation layer on sidewalls of a pattern etch structure~~silicon-containing layer comprises a layer of silicon oxide, silicon nitride, polysilicon, or combinations thereof~~.

~~10. The method of any one of claims 1 to 8, further comprising introducing an oxidizer into the chamber.~~

~~11. The method of claim 10, wherein the oxidizer is selected from the group consisting of O_2, O_3, CO, CO_2, NO, N_2O, NO_2, and combinations thereof.~~

~~12. The method of any one of claims 1 to 8, further comprising introducing an etching gas into the chamber, wherein the etching gas is selected from the group consisting of cC_5F_8, cC_4F_8, C_4F_8, C_4F_6, CF_4, CH_3F, CF_3H, CH_2F_2, COS, CS_2; CF_3I; C_2F_3I; C_2F_5I; SO_2; trans-1,1,1,4,4,4-hexafluoro-2-butene; cis-1,1,1,4,4,4-hexafluoro-2-butene; hexafluoroisobutene; hexafluorocyclobutane (trans-1,1,2,2,3,4);~~

~~pentafluorocyclobutane (1,1,2,2,3-); tetrafluorocyclobutane (1,1,2,2-); and hexafluorocyclobutane (cis-1,1,2,2,3,4).~~

7. The method of claim 6, wherein the pattern etch structure has an aspect ratio ranging from 10:1 to 100:1.

8. The method of claim 6, wherein the pattern etch structure has an aspect ratio ranging from 60:1 to 100:1.

9. The method of claim 6, wherein the pattern etch structure has a diameter ranging from approximately 40 nm to approximately 50 nm.

10. The method of claim 6, wherein the passivation layer prevents ions and radicals from etching the sidewalls.

11. The method of claim 6, wherein the etch-resistant polymer layer results in the pattern etch structure having a straight vertical profile with no bowing.

12. The method of claim 1, further comprising introducing an inert gas into the reaction chamber.

13. The method of claim 12, wherein the inert gas is selected from the group consisting of He, Ar, Xe, Kr, Ne, and combinations thereof.

14. A method of depositing an S-containing polymer passivation layer on a substrate, the method comprising:

introducing a vapor of a compound into a reaction chamber containing the substrate, the compound having a formula selected from the group consisting of: $C_2F_4S_2$ (CAS 1717-50-6), F_3CSH (CAS 1493-15-8), $F_3C\text{-}CF_2\text{-}SH$ (CAS 1540-78-9), $F_3C\text{-}CH_2\text{-}SH$ (CAS 1544-53-2), $CHF_2\text{-}CF_2\text{-}SH$ (812-10-2), $CF_3\text{-}CF_2\text{-}CH_2\text{-}SH$ (CAS 677-57-6), $F_3C\text{-}CH(SH)\text{-}CF_3$ (CAS 1540-06-3), $F_3C\text{-}S\text{-}CF_3$ (CAS 371-78-8), $F_3C\text{-}S\text{-}CHF_2$ (CAS 371-72-2), $F_3C\text{-}CF_2\text{-}S\text{-}CF2\text{-}CF_3$ (CAS 155953-22-3), $F_3C\text{-}CF_2\text{-}CF_2\text{-}S\text{-}CF_2\text{-}CF_2\text{-}CF_3$ (CAS 356-63-8), c(-S-CF_2-CF_2-CHF-CF_2-) (CAS 1035804-79-5), c(-S-CF_2-CHF-CHF-CF_2-) (CAS 30835-84-8), c(-S-CF_2-CF_2-CF_2-CF_2-CF_2-) (CAS 24345-52-6), c(-S-CFH-CF_2-CF_2-CFH-)(2 R, 5 R) (CAS 1507363-75-8), c(-S-CFH-CF_2-CF_2-

CFH-)(2 R, 5 S) (CAS 1507363-76-9), and c(-S-CFH-CF_2-CF_2-CH_2-) (CAS 1507363-77-0); and

producing fragments of the compound by activating a plasma to form the S-containing polymer passivation layer on the substrate.

15. The method of claim 14, further comprising introducing an inert gas into the reaction chamber.

16. The method of claim 15, wherein the inert gas is selected from the group consisting of He, Ar, Xe, Kr, Ne, and combinations thereof.