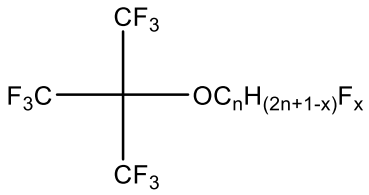
CLAIMS

What is claimed is:

1. A mixture configured to etch a thin film of an integrated circuit material, comprising:

a first compound comprising a compound corresponding in structure to Formula (I):



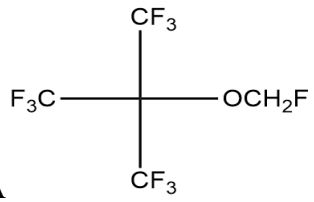
(I)

wherein n is greater than, or equal to, 1, and less than, or equal to, 3; and

wherein x is greater than, or equal to, 0, and less than, or equal to 3; and

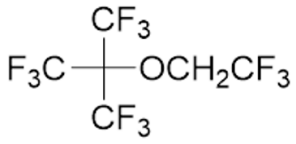
a second compound comprising oxygen (O_2), argon (Ar), octafluorocyclobutane (C_4F_8), hexafluorobutadiene (C_4F_6), carbonyl fluoride (COF_2), difluoromethane (CH_2F_2), trifluoromethane (CHF_3), carbon tetrafluoride (CF_4), octafluorocyclopentene (C5F8), 2,3,3,3-tetrafluoropro-1-ene ($C_3H_2F_4$), hexafluoropropene (C_3F_6), hexafluorocyclopropane (C_3F_6), 1,1,3,3,3-pentafluoropropene (C_3HF_5), sulfur hexafluoride (SF_6), or nitrogen trifluoride (NF_3).

2. The mixture according to claim 1, wherein the first compound comprises:



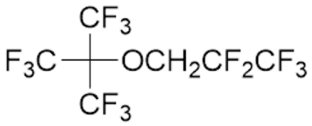
A

1,1,1,3,3,3-hexafluoro-2-(fluoromethoxy)-2-(trifluoromethyl)propane;



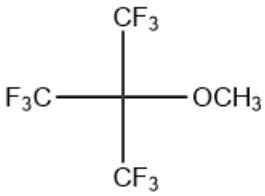
B

1,1,1,3,3,3-hexafluoro-2-(2,2,2-trifluoroethoxy)-2-(trifluoromethyl)propane;



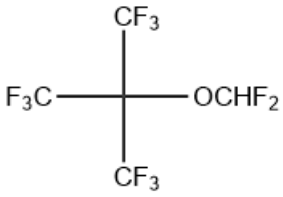
C

1,1,1,3,3,3-hexafluoro-2-(2,2,3,3,3-pentafluoropropoxy)-2-(trifluoromethyl)propane;



D

1,1,1,3,3,3-hexafluoro-2-methoxy-2-(trifluoromethyl)propane; or



E

2-(difluoromethoxy)-1,1,1,3,3,3-hexafluoro-2-(trifluoromethyl)propane.

3. The mixture according to claim 1 wherein in the second compound comprises oxygen (O_2) or argon (Ar).

4. The mixture according to claim 1, further comprising a third compound comprising oxygen, argon, helium, xenon, krypton, or nitrogen.

5. The mixture according to claim 1, wherein the first compound comprises greater than or equal to about 1% by volume of the mixture, and less than or equal to about 99% by volume of the mixture.

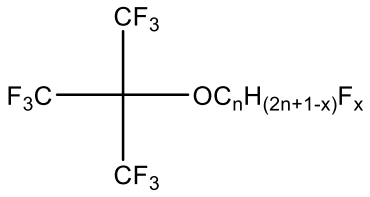
6. The mixture according to claim 1, wherein the thin film of an integrated circuit material comprises silicon, silicon oxide, silicon dioxide, silicon carbide, silicon nitride, silicon carbonitride, silicon oxycarbide, silicon oxynitride, silicon oxycarbonitride, gallium nitride, aluminum gallium nitride, gallium arsenide, aluminum gallium arsenide, indium phosphide, indium aluminum arsenide, indium gallium arsenide, silicon germanium, silicon hydrogen bromide, zinc selenide, indium tin oxide, lead zirconium titanate, molybdenum, poly-silicon, photoresist, carbon hard mask, or a combination thereof.

7. A method of etching a thin film of an integrated circuit material, comprising:

contacting a surface of the thin film of the integrated circuit material with a plasma comprising reactive ions generated by subjecting a mixture configured to etch the thin film of the integrated circuit material to a plasma generating device, thereby removing a portion of the thin film of the integrated circuit material;

wherein the mixture comprises:

a first compound comprising a compound corresponding in structure to Formula (I):



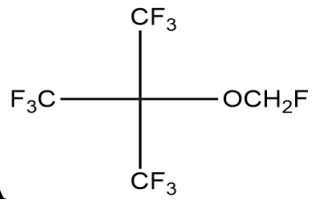
(I)

wherein n is greater than, or equal to, 1, and less than, or equal to, 3; and

wherein x is greater than, or equal to, 0, and less than, or equal to 3; and

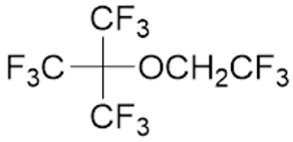
a second compound comprising oxygen (O_2), argon (Ar), octafluorocyclobutane (C_4F_8), hexafluorobutadiene (C_4F_6), carbonyl fluoride (COF_2), difluoromethane (CH_2F_2), trifluoromethane (CHF_3), carbon tetrafluoride (CF_4), octafluorocyclopentene (C_5F_8), 2,3,3,3-tetrafluoropro-1-ene ($C_3H_2F_4$), hexafluoropropene (C_3F_6), hexafluorocyclopropane (C_3F_6), 1,1,3,3,3-pentafluoropropene (C_3HF_5), sulfur hexafluoride (SF_6), or nitrogen trifluoride (NF_3).

8. The method according to claim 7, wherein the first compound comprises:



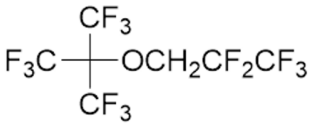
A

1,1,1,3,3,3-hexafluoro-2-(fluoromethoxy)-2-(trifluoromethyl)propane;



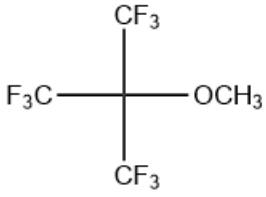
B

1,1,1,3,3,3-hexafluoro-2-(2,2,2-trifluoroethoxy)-2-(trifluoromethyl)propane;



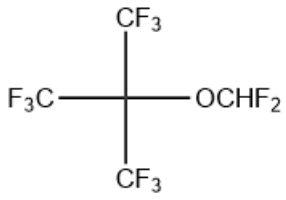
C

1,1,1,3,3,3-hexafluoro-2-(2,2,3,3,3-pentafluoropropoxy)-2-(trifluoromethyl)propane;



D

1,1,1,3,3,3-hexafluoro-2-methoxy-2-(trifluoromethyl)propane; or



E

2-(difluoromethoxy)-1,1,1,3,3,3-hexafluoro-2-(trifluoromethyl)propane.

9. The method according to claim 7, wherein the mixture further comprises a third compound comprising oxygen, argon, helium, xenon, krypton, or nitrogen.

10. The method according to claim 7, wherein the first compound comprises greater than or equal to about 1% by volume of the mixture, and less than or equal to about 99% by volume of the mixture.

11. The method according to claim 7, wherein the thin film of integrated circuit material comprises silicon, silicon oxide, silicon dioxide, silicon carbide, silicon nitride, silicon carbonitride, silicon oxycarbide, silicon oxynitride, silicon oxycarbonitride, gallium nitride, aluminum gallium nitride, gallium arsenide, aluminum gallium arsenide, indium phosphide, indium aluminum arsenide, indium gallium arsenide, silicon germanium, silicon hydrogen bromide, zinc selenide, indium tin oxide, lead zirconium titanate, molybdenum, poly-silicon, photoresist, carbon hard mask, or a combination thereof.

12. A method of patterning a thin film of integrated circuit material, comprising:

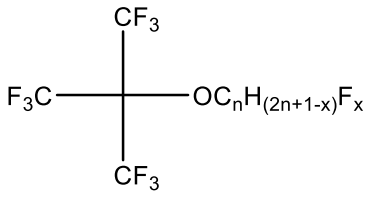
contacting a surface of the thin film with a plasma comprising reactive ions generated by subjecting a mixture configured to etch the thin film of the integrated circuit material to a plasma generating device, thereby removing a portion of the thin film and generating a pattern in the thin film of the integrated circuit material;

wherein at least a portion of the thin film is disposed between confronting surfaces of a substrate and a masking material layer, wherein the masking

material layer comprises an aperture defined therethrough and thereby exposing a portion of the surface of the thin film;

wherein the mixture comprises:

a first compound comprising a compound corresponding in structure to Formula (I):

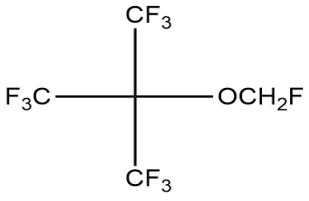


(I)

wherein n is greater than, or equal to, 1, and less than, or equal to, 3; and wherein x is greater than, or equal to, 0, and less than, or equal to 3; and

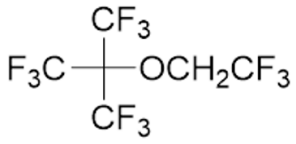
a second compound comprising oxygen (O_2), argon (Ar), octafluorocyclobutane (C_4F_8), hexafluorobutadiene (C_4F_6), carbonyl fluoride (COF_2), difluoromethane (CH_2F_2), trifluoromethane (CHF_3), carbon tetrafluoride (CF_4), octafluorocyclopentene (C5F8), 2,3,3,3-tetrafluoropro-1-ene ($C_3H_2F_4$), hexafluoropropene (C_3F_6), hexafluorocyclopropane (C_3F_6), 1,1,3,3,3-pentafluoropropene (C_3HF_5), sulfur hexafluoride (SF_6), or nitrogen trifluoride (NF_3).

13. The method according to claim 12, wherein the first compound comprises:



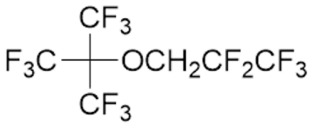
A

1,1,1,3,3,3-hexafluoro-2-(fluoromethoxy)-2-(trifluoromethyl)propane;



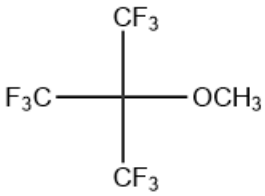
B

1,1,1,3,3,3-hexafluoro-2-(2,2,2-trifluoroethoxy)-2-(trifluoromethyl)propane;



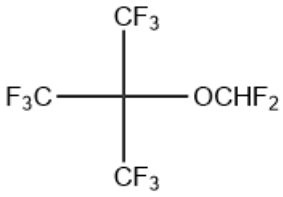
C

1,1,1,3,3,3-hexafluoro-2-(2,2,3,3,3-pentafluoropropoxy)-2-(trifluoromethyl)propane;



D

1,1,1,3,3,3-hexafluoro-2-methoxy-2-(trifluoromethyl)propane; or



E

2-(difluoromethoxy)-1,1,1,3,3,3-hexafluoro-2-(trifluoromethyl)propane.

14. The method according to claim 12, further comprising a third compound comprising oxygen, argon, helium, xenon, krypton, or nitrogen.

15. The method according to claim 12, wherein the first compound comprises greater than or equal to about 1% by volume of the mixture, and less than or equal to about 99% by volume of the mixture.

16. The method according to claim 12, wherein the thin film of an integrated circuit material comprises silicon, silicon oxide, silicon dioxide, silicon carbide, silicon nitride, silicon

carbonitride, silicon oxycarbide, silicon oxynitride, silicon oxycarbonitride, gallium nitride, aluminum gallium nitride, gallium arsenide, aluminum gallium arsenide, indium phosphide, indium aluminum arsenide, indium gallium arsenide, silicon germanium, silicon hydrogen bromide, zinc selenide, indium tin oxide, lead zirconium titanate, molybdenum, poly-silicon, or a combination thereof.

17. The method according to claim 12, wherein the thin film comprises silicon dioxide or silicon nitride and the mixture has an etch selectivity for the thin film to the masking material layer of greater than or equal to about 1.

18. The method according to claim 12, wherein the masking material layer comprises a metal mask, a carbon hard mask, or a photoresist.