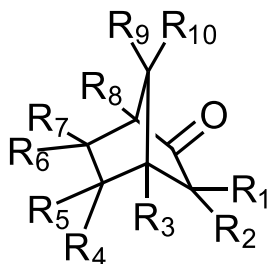


What is claimed is:

CLAIMS

1. A method comprising forming an amorphous carbon film on a substrate by exposing the substrate to a carbon precursor in the absence of a plasma and at a temperature in a range of from 100 °C to less than 600 °C, the carbon precursor having a structure of formula (I)



(I)

- wherein each of R₁-R₁₀ are independently selected from H, a halogen, or -a substituted or unsubstituted C₁-C₄ alkyl.
2. The method of claim 1, wherein the carbon precursor comprises one or more of camphor, L-fenchone, 3-chloro-2-norbornanone, norbornanone, 1,3,7,7-tetramethyl-2-norbornanone, norcamphor, (1R)-(-)-fenchone, (+)-fenchone, (-)-or fenchone.
 3. The method of claim 1, wherein the ~~substrate is maintained at a~~ temperature ~~range of about 100 °C to about 650 °C, and wherein forming the amorphous carbon film occurs at a pressure is~~ in a range of ~~about 1 Torr~~from 300 °C to about 600 Torr~~°C~~.
 4. The method of claim 1, wherein the carbon precursor is heated in an ampoule and flowed to the substrate with a carrier gas ~~comprising~~.
 - 4.5. The method of claim 4, wherein the carrier gas comprises one or more of hydrogen (H₂), argon (Ar), helium (He), xenon (Xe), or nitrogen (N₂).

~~5.6.~~ The method of claim 1, wherein the amorphous carbon film is formed by a thermal decomposition process.

~~6.7.~~ The method of claim 1, wherein the amorphous carbon film is one or more of conformal or ashable.

~~8.~~ The method of claim 1, wherein the amorphous carbon film is a hard mask layer, ~~and~~.

~~7.9.~~ The method of claim 8, wherein the substrate comprises a layer to be patterned.

~~8.10.~~ The method of claim 1, wherein the substrate comprises one or more of an adhesion layer or a dielectric layer.

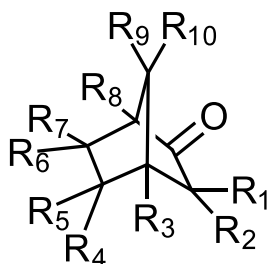
~~9.11.~~ The method of claim 1, wherein the substrate comprises at least one feature selected from a peak, a trench, or a via, ~~and wherein the amorphous carbon film is conformal.~~

~~12.~~ The method of claim 11, wherein the amorphous carbon film is conformal.

~~13.~~ The method of claim 1, wherein the amorphous carbon film has a hydrogen content in a range of from 10 to 45 atomic %.

~~10.14.~~ A method of etching a substrate comprising:

forming an amorphous carbon hard mask on the substrate, the amorphous carbon hard mask deposited in the absence of a plasma and at a temperature range of from 100 °C to less than 600 °C, and the amorphous carbon hard mask having at least one opening and formed by exposing the substrate to a carbon precursor having a structure of formula (I)



(I)

wherein each of R₁-R₁₀ are independently selected from H, a halogen or a substituted or unsubstituted C₁-C₄ alkyl; and
etching the substrate through the at least one opening.

11.15. The method of claim 1014, wherein the carbon precursor comprises one or more of camphor, L-fenchone, 3-chloro-2-norbornanone, norbornanone, 1,3,7,7-tetramethyl-2-norbornanone, norcamphor, (1*R*)-(-)-fenchone, (+)-fenchone, (-)-or fenchone.

12.16. The method of claim 1014, further comprising forming a photoresist prior to etching, the photoresist formed between the substrate and the amorphous carbon hard mask or on the amorphous carbon hard mask.

13.17. The method of claim 1014, further comprising removing the amorphous carbon hard mask after etching the substrate.

18. The method of claim 1017, wherein the amorphous carbon hard mask is removed by ashing.

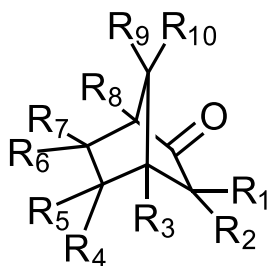
14.19. The method of claim 14, wherein the amorphous carbon hard mask is formed at a temperature less than about 600 °C and a pressure in a range of about 1 Torr to about 600 Torr.

15.20. A method comprising:

providing a substrate having a substrate surface;

exposing the substrate to a carbon precursor at a temperature in a range of

~~about~~from 100 °C to ~~about 650~~600 °C and a pressure in a range of ~~about 1~~from Torr to ~~about~~ 600 Torr to form a carbon hard mask on the substrate surface, the carbon hard mask deposited in the absence of a plasma, and the carbon precursor having a structure of formula (I)



(I)

wherein each of R₁-R₁₀ are independently selected from H, a halogen or a substituted or unsubstituted C₁-C₄ alkyl;

etching at least a portion of the substrate through an opening in the carbon hard mask; and

removing the carbon hard mask from the substrate surface by ashing.