CLAIMS

~~What is claimed is:~~

1. A method for etching features into a silicon based etch layer through a patterned hard mask in a plasma processing chamber, comprising:

providing a silicon sputtering to sputter silicon from the silicon based etch layer onto sidewalls of the patterned hard mask to form sidewalls on the patterned hard mask, wherein the silicon is sputtered primarily in the direction from the silicon based etch layer onto the sidewalls of the patterned hard mask; and

etching the etch layer through the patterned hard mask.

2. The method, as recited in claims 1, wherein the providing the silicon sputtering comprises:

flowing a sputtering gas into the plasma processing chamber, wherein the sputtering gas comprises a noble gas and is etchant free;

forming the sputtering gas into a plasma to generate noble gas ions; and

providing a bias that accelerates the noble gas ions in the plasma to the silicon based etch layer with sufficient energy to sputter silicon from the silicon based etch layer.

3. The method, as recited in claim 2, wherein the providing a bias provides a bias of greater than 200 volts.

4. The method, as recited in claim 2, wherein the sputtering gas consists essentially of at least one noble gas.

5. The method, as recited in claim 4, wherein the at least one noble gas comprises argon.

6. The method, as recited in claim 2, wherein the sputtering gas is at least 95% argon.

7. The method, as recited in claim 2, further comprising forming the sputtered silicon into silicon oxide.

8. The method, as recited in claim 7, wherein the forming the sputtered silicon into silicon oxide comprises:

flowing oxygen into the plasma process chamber subsequent to providing the silicon sputtering and before etching the etch layer; and

forming the oxygen into a plasma.

9. The method, as recited in claim 8, wherein the forming the sputtered silicon into silicon oxide, further comprises providing a bias of less than 200 volts.

10. The method, as recited in claim 7, wherein the forming the sputtered silicon into silicon oxide comprises flowing oxygen into the plasma process chamber during providing the silicon sputtering and before etching the etch layer.

11. The method, as recited in claim 10, wherein the sputtering gas consists essentially of at least one noble gas and oxygen.

12. The method, as recited in claim 11, wherein the at least one noble gas comprises argon.

13. The method, as recited in claim 12, wherein the sputtering gas is at least 95% argon.

14. The method, as recited in claim 10, wherein the sputtering gas consists essentially of 90% of at least one noble gas and the remaining consisting essentially of O_2.

15. The method, as recited in claim 14, wherein the at least one noble gas is argon.

16. A method for etching features into a silicon based etch layer through a patterned hard mask in a plasma processing chamber, comprising:

providing a silicon sputtering to sputter silicon from the silicon based etch layer onto sidewalls of the patterned hard mask to form sidewalls on the patterned hard mask, wherein the silicon is sputtered primarily in the direction from the silicon based etch layer onto the sidewalls of the patterned hard mask, comprising:

flowing a sputtering gas into the plasma processing chamber, wherein the sputtering gas comprises an argon gas and is etchant free;

forming the sputtering gas into a plasma to generate argon ions;

providing a bias greater than 200 volts that accelerates the argon ions in the plasma to the silicon based etch layer with sufficient energy to sputter silicon from the silicon based etch layer; and

stopping the flow of the sputtering gas; and

etching the etch layer through the patterned hard mask.

17. The method, as recited in claim 16, further comprising forming the sputtered silicon into silicon oxide.

18. The method, as recited in claim 16, wherein the sputtering gas consists essentially of 90% Ar.