

CLAIMS

1. A method for selectively etching silicon oxide, comprising:
providing a surface reaction phase, comprising:
 flowing a surface reaction gas comprising hydrogen, nitrogen and
fluorine containing components;
 forming the surface reaction gas into a plasma to form silicon oxide
into a compound layer comprising silicon, hydrogen, nitrogen, and fluorine;
 heating the plasma by,
 flowing a heating gas, wherein the heating gas comprises H₂ or
N₂ or NH₃, and wherein the heating gas is NF₃ and HF free;
 forming the heating gas into a plasma; and
 stopping the flow of the heating gas;
 stopping the flow of the surface reaction gas; and
 wet treating the surface to remove the compound layer;
wherein the surface reaction gas comprises:
 NF₃ or HF; and
 H₂ or N₂ or NH₃;
and the compound is an amine containing salt.
2. The method, as recited in claim 1, wherein the surface reaction gas comprises NF₃ and
NH₃ and wherein the heating gas comprises NH₃ and is free of NF₃.
3. The method, as recited in claim 2, wherein the providing the surface reaction phase
and the heating the plasma make up a dry treatment, wherein the dry treatment is repeated
cyclically a plurality of times.
4. The method, as recited in claim 3, wherein the dry treatment is performed at a
pressure of at least 5 mTorr.
5. The method, as recited in claim 4, wherein the surface reaction gas and the heating
gas both further comprise flowing a noble gas.
6. The method, as recited in claim 5, wherein a continuous plasma is maintained during

the cyclically repeated dry treatment.

7. The method, as recited in claim 1, wherein the providing the surface reaction phase and the heating the plasma make up a dry treatment, wherein the dry treatment is repeated cyclically a plurality of times.

8. The method, as recited in claim 1, wherein providing the surface reaction phase and wet treating the surface are cyclically repeated a plurality of times.

9. The method, as recited in claim 8, wherein the wet treating uses a hydrophobic solvent that is able to dissolve the compound without oxidizing silicon.

10. The method, as recited in claim 1, wherein the wet treating uses a solvent that is able to dissolve the compound without oxidizing silicon.

11. A method for selectively etching silicon oxide, comprising
providing a dry treatment, comprising a plurality of cycles, wherein each cycle comprises:

providing a surface reaction phase, comprising:

flowing a surface reaction gas comprising NF_3 or HF and further comprising H_2 or N_2 or NH_3 ;

forming the surface reaction gas into a plasma to form silicon oxide into a compound comprising silicon, hydrogen, nitrogen, and fluorine;

heating the plasma to volatize the compound, comprising:

flowing a heating gas, wherein the heating gas comprises H_2 or N_2 or NH_3 , and wherein the heating gas is NF_3 and HF free;

forming the heating gas into a plasma; and

stopping the flow of the heating gas;

stopping the flow of the surface reaction gas; and

wet treating the surface to remove the compound.

12. The method, as recited in claim 11, wherein the surface reaction gas comprises NF_3 and NH_3 and wherein the heating gas comprises NH_3 and is free of NF_3 .

13. The method, as recited in claim 12, wherein the dry treatment is performed at a pressure of at least 5 mTorr.