WHAT IS CLAIMED IS:

1. A method of etching silicon oxide from multiple trenches on a surface of a patterned substrate in a substrate processing region of a substrate processing chamber, the method comprising the sequential steps of:

dry etching the silicon oxide in each of the multiple trenches in a first dry-etch stage to form first solid by-products on the surface of a remaining silicon oxide in the multiple trenches, wherein the silicon oxide is removed at a first etch rate during the first dry-etch stage;

dry etching the silicon oxide in each of the multiple trenches in a second dry-etch stage to form second solid by-products on the surface of a remaining silicon oxide in the multiple trenches, wherein a second etch rate of the silicon oxide during the second dry-etch stage is less than the first etch rate; and

sublimating the first and second solid by-products from the multiple trenches.

2. The method of claim 1 wherein the first solid by-products are not sublimated between the first dry-etch stage and the second dry-etch stage.

3. The method of claim 1 wherein essentially no delay between the first dry-etch stage and the second dry-etch stage.

4. The method of claim 1 wherein a width of each of the multiple trenches is less than 35 nm.

5. The method of claim 1 wherein a duration of the first dry-etch stage exceeds a duration of the second dry-etch stage.

6. The method of claim 1 wherein a duration of the first dry-etch stage is between about 15 seconds and about 1 minute.

7. The method of claim 1 wherein a duration of the second dry-etch stage is between about 5 seconds and about 30 seconds.

8. The method of claim 1 wherein the silicon oxide is maintained below 60°C during the first and second dry-etch stages.

9. The method of claim 1 wherein the silicon oxide is raised above 90°C during the operations of sublimating the first and second solid by-products from the multiple trenches.

10. The method of claim 1 wherein the first etch rate is more than about twice the second etch rate.

11. The method of claim 1 wherein the first etch rate is more than about five times the second etch rate.

12. The method of claim 1 wherein the dry etching of the first dry-etch stage becomes self-limiting in about one minute or less and the dry etching of the second dry-etch stage becomes self-limiting in about two minutes or more.

13. The method of claim 1 wherein each of the dry etching operations comprise:

flowing a fluorine-containing precursor and a hydrogen-containing precursor into a remote plasma region fluidly coupled to the substrate processing region while forming a plasma in the remote plasma region to produce plasma effluents.

14. The method of claim 13 wherein the hydrogen-containing precursor comprises at least one precursor selected from the group consisting of atomic hydrogen, molecular hydrogen, ammonia, a hydrocarbon and an incompletely halogen-substituted hydrocarbon.

15. The method of claim 13 wherein the fluorine-containing precursor comprises at least one precursor selected from the group consisting of nitrogen trifluoride, hydrogen fluoride, diatomic fluorine, monatomic fluorine and fluorine-substituted hydrocarbons

What is claimed is:

1. A method of etching silicon oxide from multiple trenches on a surface of a patterned substrate in a substrate processing region of a substrate process chamber, the method comprising the sequential steps of:

dry etching the silicon oxide in each of the multiple trenches in a first dry-etch stage using plasma effluents generated from a fluorine-containing precursor and a hydrogen-containing precursor to form first solid by-products on the surface of a remaining silicon oxide in the multiple trenches, wherein the silicon oxide is removed at a first etch rate during the first dry-etch stage;

increasing a flow ratio of the hydrogen-containing precursor to the fluorine-containing precursor and/or decreasing plasma power used to form the plasma effluents to reduce an etch rate of the dry etching the silicon oxide in each of the multiple trenches in a second dry-etch stage to form second solid-by-products on the surface of remaining silicon oxide in the multiple trenches, wherein a second etch rate of the silicon oxide during the second dry-etch stage is less than the first etch rate; and

sublimating the first and second solid by-products from the multiple trenches.

2. The method of claim 1 wherein the first solid by-products are not sublimated between the first dry-etch stage and the second dry-etch stage.

3. The method of claim 1 wherein essentially no delay between the first dry-etch stage and the second dry-etch stage.

4. The method of claim 1 wherein a width of each of the multiple trenches is less than 35 nm.

5. The method of claim 1 wherein a duration of the first dry-etch stage exceeds a duration of the second dry-etch stage.

6. The method of claim 1 wherein a duration of the first dry-etch stage is between about 15 seconds and about 1 minute.

7. The method of claim 1 wherein a duration of the second dry-etch stage is between about 5 seconds and about 30 seconds.

8. The method of claim 1 wherein the silicon oxide is maintained below 60°C. during the first and second dry-etch stages.

9. The method of claim 1 wherein the silicon oxide is raised above 90°C. during the operations of sublimating the first and second solid by products from the multiple trenches.

10. The method of claim 1 wherein the first etch rate is more than about twice the second etch rate.

11. The method of claim 1 wherein the first etch rate is more than about three times the second etch rate.

12. The method of claim 1 wherein the first etch rate is more than about five times the second etch rate.

13. The method of claim 1 wherein the first etch rate is between one and about five times the second etch rate.

14. The method of claim 1 wherein the dry etching of the first dry-etch stage becomes self-limiting in about one minute or less and the dry etching of the second dry-etch stage becomes self-limiting in about two minutes or more.

15. The method of claim 1 wherein each of the dry etching operations comprise:

flowing a fluorine-containing precursor and a hydrogen-containing precursor into a remote plasma region fluidly coupled to the substrate processing region while forming a plasma in the remote plasma region to produce plasma effluents.

16. The method of claim 15 wherein the hydrogen-containing precursor comprises at least one precursor selected from the group consisting of atomic hydrogen, molecular hydrogen, ammonia, a hydrocarbon and an incompletely halogen-substituted hydrocarbon.

17. The method of claim 15 wherein the fluorine-containing precursor comprises at least one precursor selected from the group consisting of nitrogen trifluoride, hydrogen fluoride, diatomic fluorine, monatomic fluorine and fluorine-substituted hydrocarbons.

18. A multistep method of etching silicon oxide from multiple trenches on a surface of a patterned substrate positioned in a substrate processing chamber, the method comprising:

etching the silicon oxide layer in a first dry etch step using plasma effluents generated from a fluorine-containing precursor and a hydrogen-containing precursor, wherein the first dry etch step removes a first portion of the silicon oxide from the multiple trenches at a first etch rate and form first solid by-products;

increasing a flow ratio of the hydrogen-containing precursor to the fluorine-containing precursor and/or decreasing plasma power used to form the plasma effluents to

remove a second portion of the silicon oxide layer from the multiple trenches at a second etch rate that is less than the first etch rate;

etching the silicon oxide layer in a second dry etch step using the second set of process parameters, wherein the second dry etch step removes a second portion of the silicon oxide from the multiple trenches at the second etch rate and forms second by-products; and

thereafter, sublimate the first and second solid by-products.

19. The method of claim 1 wherein the hydrogen-containing source comprises ammonia, the fluorine-containing source comprises nitrogen trifluoride and reducing the etch rate comprises increasing a flow ratio of the hydrogen-containing source to the fluorine-containing source.

20. The method of claim 1 wherein reducing the etch rate comprises reducing the plasma power by between 30-50 from the first dry etch stage to the second dry etch stage.