CLAIMS

1. A method of processing a semiconductor substrate, the method comprising:

(a) providing a semiconductor substrate having an exposed SnO_2 layer to an etching apparatus, wherein the etching apparatus comprises:

(i) a process chamber having a substrate holder configured for holding the semiconductor substrate during etching and an inlet configured to admit a process gas into the process chamber;

(ii) a plasma generator configured for generating a plasma in the process gas; and

(iii) a controller configured to execute a program for:

causing the etching of the SnO_2 layer on the semiconductor substrate at a temperature of less than about 100°C, and a pressure of between about 1-175 mTorr, wherein causing the etching of the SnO_2 layer comprises causing an exposure of the semiconductor substrate to a plasma formed in the process gas such that the etching results in a formation of a volatile tin hydride, wherein the process gas comprises at least about 50% H_2 and does not include methane, causing maintenance of etching process conditions during the etching of the SnO_2 layer on the semiconductor substrate such that the formed volatile tin hydride does not decompose to deposit particles on the semiconductor substrate; and

causing a removal of the formed volatile tin hydride from the process chamber by at least one of a purging and an evacuation of the process chamber; and

(b) etching the SnO_2 layer at a temperature of less than about 100°C, and a pressure of between about 1-175 mTorr, wherein the etching comprises exposing the semiconductor substrate to a plasma formed in the process gas such that the etching results in a formation of a volatile tin hydride, wherein the process gas comprises at least about 50% H_2 and does not include methane, maintaining etching process conditions during the etching of the SnO_2 layer on the semiconductor substrate such that the formed volatile tin hydride does not decompose to deposit particles on the semiconductor substrate and removing the formed volatile tin hydride from the

process chamber by at least one of the purging and the evacuation of the process chamber.

2. The method of claim 1, wherein the semiconductor substrate provided in (a) further comprises an exposed second material selected from the group consisting of SiO_2, SiC, SiN, SiOC, SiNO, SiCNO, and SiCN, and wherein (b) comprises etching SnO_2 with an etch selectivity of at least about 10 relative to the second material.

3. The method of claim 1, wherein the semiconductor substrate provided in (a) further comprises an exposed second material selected from the group consisting of SiO_2, SiC, SiN, SiOC, SiNO, SiCNO, and SiCN, and wherein (b) comprises etching SnO_2 with an etch selectivity of at least about 80 relative to the second material.

4. The method of claim 1, wherein the etching in (b) comprises exposing a second material selected from the group consisting of SiO_2, SiC, SiN, SiOC, SiNO, SiCNO, and SiCN, and wherein (b) further comprises etching SnO_2 after the second material has been exposed with an etch selectivity of at least about 10 relative to the second material.

5. The method of claim 1, wherein the process gas comprises at least about 80% H_2.

6. The method of claim 1, wherein the process gas consists essentially of H_2.

7. The method of claim 1, wherein the process gas consists essentially of H_2 and an inert gas.

8. The method of claim 1, wherein the process gas further comprises Cl_2.

9. The method of claim 1, wherein the process gas comprises H_2 and He.

10. The method of claim 1, wherein (b) comprises selectively etching SnO_2 in a presence of SiO_2, wherein the etch selectivity is at least 10.

11. An apparatus for etching an SnO_2 layer, the apparatus comprising:

(a) a process chamber having a substrate holder configured for holding a semiconductor substrate during etching and an inlet configured to admit a process gas into the process chamber;

(b) a plasma generator configured for generating a plasma in the process gas; and

(c) a controller configured to execute program instructions for:

(i) causing the etching of the SnO_2 layer on the semiconductor substrate at a temperature of less than about 100°C, and a pressure of between about 1-175 mTorr, wherein causing the etching comprises causing an exposure of the SnO_2 layer on the semiconductor substrate to a plasma formed in the process gas such that the etching results in a formation of a volatile tin hydride, wherein the process gas comprises at least about 50% H_2 and does not include methane;

(ii) causing maintenance of etching process conditions during the etching of the SnO_2 layer on the semiconductor substrate such that the formed volatile tin hydride does not decompose to deposit particles on the semiconductor substrate; and

(iii) causing a removal of the formed volatile tin hydride from the process chamber by at least one of a purging and an evacuation of the process chamber.

12. The apparatus of claim 11, wherein the program instructions for causing the etching comprise program instructions for causing an exposure of the semiconductor substrate to a plasma formed in a process gas comprising at least about 80% H_2.

13. The apparatus of claim 11, wherein the process gas in (i) consists essentially of H_2 and an inert gas.

14. The apparatus of claim 11, wherein the program instructions for causing the etching comprise program instructions for causing the etching of SnO_2 with an etch selectivity of at least about 10 relative to a second material on the semiconductor substrate, wherein the second material is selected from the group consisting of SiO_2, SiC, SiN, SiOC, SiNO, SiCNO, and SiCN.

15. The apparatus of claim 11, wherein the process gas further comprises an inert gas.

16. The apparatus of claim 11, wherein the process gas further comprises helium.

17. The apparatus of claim 11, wherein the process gas consists essentially of H_2.

18. The apparatus of claim 11, wherein the program instructions for causing the etching comprise program instructions for causing an exposure of the semiconductor substrate to a plasma formed in a process gas comprising at least about 50% H_2, without externally biasing the semiconductor substrate.