Claims:

1. A method for processing a substrate, comprising:

providing a substrate having an oxide layer disposed thereon, wherein the oxide layer is formed atop the substrate in a first process; and

treating the oxide layer with a plasma oxidation process using a plasma formed from a process gas comprising an oxygen-containing gas, wherein the first process is different than the plasma oxidation process.

2. The method of claim 1, wherein the oxide layer comprises silicon oxide (SiO_2), silicon oxynitride (SiON), hafnium oxide (HfO_2), or aluminum oxide (Al_2O_3).

3. The method of claim 1, wherein the oxide layer has one or more defects comprising at least one of cracks, lattice defects, unbonded elements, deviations from ideal stoichiometry, or impurities, and wherein treating the oxide layer with the plasma repairs the one or more defects.

4. The method of any of claims 1-3, wherein the oxygen-containing gas comprises at least one of oxygen (O_2), ozone (O_3), water vapor (H_2O), nitrous oxide (N_2O), or nitric oxide (NO).

5. The method of claim 4, wherein the oxygen-containing gas comprises up to about 50 percent of the composition of the process gas.

6. The method of claim 4, wherein the oxygen-containing gas comprises up to about 20 percent of the composition of the process gas.

7. The method of claim 4, wherein the oxygen-containing gas comprises up to about 4 percent of the composition of the process gas.

8. The method of any of claims 1-7, wherein the process gas further comprises a second gas, wherein the second gas comprises at least one of hydrogen (H_2), deuterium (D_2), argon (Ar), helium (He), or neon (Ne).

9. The method of any of claims 1-8, wherein treating the oxide layer further comprises:

exposing the oxide layer to the plasma at a pressure of up to about 500 mTorr.

10. The method of any of claims 1-9, wherein treating the oxide layer further comprises:

maintaining the substrate at a temperature between about 50 to about 350 degrees Celsius.

11. The method of any of claims 1-10, wherein the plasma has an ion energy of up to about 30 eV.

12. The method of any of claims 1-11, wherein the oxide layer has a thickness of up to about 80 Angstroms prior to exposure to the plasma.

13. The method of any of claims 1-12, wherein treating the oxide layer increases the thickness of the oxide layer by less than about 30 percent.

14. The method of any of claims 1-13, wherein providing the substrate having the oxide layer disposed thereon comprises forming the oxide layer atop the substrate and further comprising:

repeating a sequence of forming the oxide layer atop the substrate and subsequently treating the oxide layer to form the oxide layer to a desired thickness.

15. The method of any of claims 1-14, wherein providing the substrate having the oxide layer disposed thereon comprises one or more of:

forming the oxide layer atop at least one of the substrate or one or more devices formed on the substrate; or

thermally oxidizing a surface of at least one of the substrate or one or more devices formed on the substrate to form the oxide layer.

CLAIMS:

1. A method for processing a substrate disposed on a substrate support in a process chamber, comprising:

providing a substrate having an oxide layer disposed thereon, wherein the oxide layer is formed atop the substrate in a first process; and

treating the oxide layer with a plasma oxidation process using a plasma formed from a process gas comprising an oxygen-containing gas, wherein the first process is different than the plasma oxidation process and, wherein the plasma is generated using an RF power source of up to about 5000 Watts coupled to the process chamber, and wherein the plasma has an ion energy of about 15 eV to about 25 eV.

2. The method of claim 1, wherein the oxide layer comprises silicon oxide (SiO_2), silicon oxynitride (SiON), hafnium oxide (HfO_2), or aluminum oxide (Al_2O_3).

3. The method of claim 1, wherein the oxide layer has one or more defects comprising at least one of cracks, lattice defects, unbonded elements, deviations from ideal stoichiometry, or impurities, and wherein treating the oxide layer with the plasma repairs the one or more defects.

4. The method of claim 1, wherein the process gas further comprises a second gas, wherein the second gas comprises at least one of hydrogen (H_2), deuterium (D_2), argon (Ar), helium (He), or neon (Ne).

5. The method of claim 1, wherein the oxygen-containing gas comprises oxygen (O_2), ozone (O_3), water vapor (H_2O), nitrous oxide (N_2O), or nitric oxide (NO).

6. The method of claim 5, wherein the oxygen-containing gas comprises up to about 50 percent of the composition of the process gas.

7. The method of claim 5, wherein the oxygen-containing gas comprises up to about 4 percent of the composition of the process gas.

8. The method of claim 1, wherein treating the oxide layer further comprises:
exposing the oxide layer to the plasma at a pressure of up to about 500 mTorr.

9. The method of claim 1, wherein treating the oxide layer further comprises:
maintaining the substrate at a temperature between about 50 to about 350 degrees Celsius.

10. The method of claim 1, wherein the oxide layer has a thickness of up to about 80 Angstroms prior to exposure to the plasma.

11. The method of claim 1, wherein treating the oxide layer increases the thickness of the oxide layer by less than about 30 percent.

12. The method of claim 1, wherein providing the substrate having the oxide layer disposed thereon comprises forming the oxide layer atop the substrate and further comprising:
repeating a sequence of forming the oxide layer atop the substrate and subsequently treating the oxide layer to form the oxide layer to a desired thickness.

13. The method of claim 1, wherein providing the substrate having the oxide layer disposed thereon comprises:
forming the oxide layer atop at least one of the substrate or one or more devices formed on the substrate.

14. The method of claim 1, wherein providing the substrate having the oxide layer disposed thereon comprises:
thermally oxidizing a surface of at least one of the substrate or one or more devices formed on the substrate to form the oxide layer.

15. A method for processing a substrate disposed on a substrate support in a process chamber, comprising:

providing a substrate having a oxide layer disposed thereon and formed by a first process, the oxide layer including one or more defects; and

exposing the oxide layer to a plasma formed from a process gas comprising an oxygen-containing gas in a second process, different than the first, to repair the one or more defects, wherein the plasma is generated using an RF power source of up to about 5000 Watts coupled to the process chamber and wherein the plasma has an ion energy of about 15 eV to about 25 eV.

16. The method of claim 15, wherein providing the substrate further comprises:

forming the oxide layer on the substrate to a desired thickness prior to exposing the oxide layer to the plasma.

17. The method of claim 15, wherein the oxide layer comprises silicon oxide (SiO_2), silicon oxynitride (SiON), Hafnium oxide (HfO_2), or aluminum oxide (Al_2O_3).

18. The method of claim 1, wherein the plasma is generated using an inductively coupled plasma source coupled to the process chamber.

19. The method of claim 1, wherein the plasma is a quasi-remote plasma.