Claims:

1. A method of post-treating a silicon nitride (SiN)-based dielectric film formed on a surface of a substrate, comprising:

positioning a substrate having a silicon nitride (SiN)-based dielectric film formed thereon in a processing chamber; and

exposing the silicon nitride (SiN)-based dielectric film to helium-containing high-energy low-dose plasma in the processing chamber, wherein

energy of helium ions in the helium-containing high-energy low-dose plasma is between 1eV and 3.01eV, and

flux density of the helium ions in the helium-containing high-energy low-dose plasma is between 5×10^{15} ions/cm^2·sec and 1.37×10^{16} ions/cm^2·sec.

2. The method according to claim 1, wherein the silicon nitride (SiN)-based dielectric film comprises S–H bonds.

3. The method according to claim 1, wherein the silicon nitride (SiN)-based dielectric film comprises N–H bonds.

4. The method according to claim 1, wherein the substrate is at a temperature between 10°C and 200° C during the exposure of the silicon nitride (SiN)-based dielectric film to the helium-containing high-energy low-dose plasma.

5. The method according to claim 1, wherein the substrate is at a pressure between 15 mTorr and 300 mTorr during the exposure of the silicon nitride (SiN)-based dielectric film to the high density plasma.

6. The method according to claim 1, wherein the substrate is made of a material selecting from a group consisting of metal, semiconductor, and plastic.

7. A method of post-treating a silicon-based film formed on a surface of a substrate, comprising:

positioning a substrate having a silicon-based film formed thereon in a processing chamber; and

exposing the silicon-based film to helium-containing high-energy low-dose plasma in the processing chamber, wherein

energy of helium ions in the helium-containing high-energy low-dose plasma is between 1eV and 3.01eV, and

flux density of the helium ions in the helium-containing high-energy low-dose plasma is between 5×10^{15} ions/cm^2·sec and 1.37×10^{16} ions/cm^2·sec.

8. The method according to claim 7, wherein the silicon-based film comprises silicon nitride (SiN).

9. The method according to claim 7, wherein the silicon-based film comprises S–H bonds.

10. The method according to claim 7, wherein the silicon-based film comprises N–H bonds.

11. The method according to claim 7, wherein the substrate is at a temperature between 10°C and 200° C during the exposure of the silicon-based film to the helium-containing high-energy low-dose plasma.

12. The method according to claim 7, wherein the substrate is at a pressure between 15 mTorr and 300 mTorr during the exposure of the silicon-based film to the high density plasma.

13. The method according to claim 1, wherein the substrate is made of a material selecting from a group consisting of metal, semiconductor, and plastic.

14. A method of forming and post-treating a silicon nitride (SiN)-based dielectric film on a surface of a substrate, comprising:

delivering a dielectric precursor onto a substrate disposed in a processing region of a first chamber, the dielectric precursor comprising silicon and nitrogen;

providing radical flux in the processing region of the first chamber; and

exposing the delivered dielectric precursor to helium-containing high-energy low-dose plasma in a second chamber, wherein

energy of helium ions in the helium-containing high-energy low-dose plasma is between 1eV and 3.01eV, and

flux density of the helium ions in the helium-containing high-energy low-dose plasma is between 5×10^{15} ions/cm^2·sec and 1.37×10^{16} ions/cm^2·sec.

15. The method according to claim 14, wherein the substrate is at a temperature between 10°C and 200° C during the exposure of the silicon nitride (SiN)-based dielectric film to the helium-containing high-energy low-dose plasma.

16. The method according to claim 14, wherein the substrate is at a pressure between 15 mTorr and 300 mTorr during the exposure of the silicon nitride (SiN)-based dielectric film to the high density plasma.

17. The method according to claim 14, wherein the substrate is made of a material selecting from a group consisting of metal, semiconductor, and plastic.

18. The method according to claim 14, wherein the dielectric precursor is an organosilicon compound that includes silicon, nitrogen, hydrogen, and chlorine.

19. The method according to claim 14, wherein the dielectric precursor is an organosilicon compound that includes silicon, nitrogen, hydrogen, and oxygen.

20. The method according to claim 14, wherein the radical flux comprises radical gas selected from a group consisting of oxygen (O_2), ozone (O_3), water (H_2O), ammonia (NH_3), hydrazine (N_2H_4), nitrogen dioxide (NO_2), nitrogen (N_2), propylene (C_3H_6), and acetylene (C_2H_2).