

~~What is claimed is:~~ **Claims**

1. A method of forming a film stack with reduced defects, comprising:
positioning a substrate on a substrate support within a processing chamber;
sequentially depositing polysilicon layers and silicon oxide layers to produce a lower portion of the film stack on the substrate;
removing the substrate containing the lower portion of the film stack from the processing chamber;
exposing the processing chamber to a condition process after removing the substrate containing the lower portion of the film stack from the processing chamber;
replacing the substrate containing the lower portion of the film stack into the processing chamber;
supplying a current of greater than 5 ampere (A) to a plasma profile modulator while generating a deposition plasma within the processing chamber;
exposing the substrate to the deposition plasma while sequentially depositing the polysilicon layers and the silicon oxide layers to produce an upper portion of the film stack;
and
maintaining the processing chamber at a pressure of greater than 2 Torr to about 100 Torr while sequentially depositing the polysilicon layers and the silicon oxide layers.
2. The method of claim 1, wherein an upper surface of the film stack comprises less than 200 defects having a particle size of less than 0.5 μm , and wherein an upper surface of the film stack comprises less than 50 defects having a particle size of greater than 0.5 μm .
3. The method of claim 1, further comprising adjusting the deposition plasma with the plasma profile modulator while depositing the polysilicon layers and the silicon oxide layers, and wherein the current to the plasma profile modulator is greater than 8 A to about 20 A while generating the deposition plasma.

4. The method of claim 1, wherein the current to the plasma profile modulator is about 9 A to about 15 A while generating the deposition plasma, and wherein the deposition plasma is at a power of about 200 watts to about 3,000 watts.

5. The method of claim 1, wherein the processing chamber further comprises a faceplate disposed above the substrate support, and prior to depositing the polysilicon layers and the silicon oxide layers, further comprising moving the substrate support to an upper position separated from the faceplate by a narrow spacing, wherein the narrow spacing is about 50 mils to 1,000 mils, as measured between the substrate support and the faceplate.

6. The method of claim 5, wherein the narrow spacing is about 100 mils to about 500 mils.

7. The method of claim 1, wherein the processing chamber further comprises a faceplate disposed above the substrate support, and subsequent to producing the film stack, further comprising:

moving the substrate support containing the substrate to a lower position separated from the faceplate by a wide spacing, wherein the wide spacing is greater than 1,000 mils, as measured between the substrate support and the faceplate; and

maintaining a pressure of about 3 Torr to about 50 Torr within the processing chamber while moving the substrate support containing the substrate to the lower position.

7.8. The method of claim 7, wherein the wide spacing is about 2,000 mils to about 10,000 mils, and wherein the processing chamber is maintained at a pressure of about 10 Torr to about 40 Torr while moving the substrate support containing the substrate to the lower position.

9. The method of claim 1, further comprising:

introducing a process gas into the processing chamber at a rate of greater than 2 L/min; and

igniting the process gas to generate the deposition plasma, wherein the process gas comprises argon, helium, neon, silane, or any combination thereof.

10. The method of claim 1, further comprising:

maintaining a pressure of about 3 Torr to about 50 Torr within the processing chamber while depositing the polysilicon layers and the silicon oxide layers; and

heating the substrate to a temperature of about 450°C to about 650°C while depositing the polysilicon layers and the silicon oxide layers.

11. The method of claim 1, wherein the film stack comprises about 30 pairs to about 100 pairs of the polysilicon layer and the silicon oxide layer; and wherein the polysilicon layer comprises a p-type doped-polysilicon or an n-type doped-polysilicon.

~~9. The method of claim 1, wherein the film stack comprises a lower portion and an upper portion, wherein each of the lower and upper portions comprises the polysilicon layers and the silicon oxide layers, and wherein the lower portion is disposed on the substrate and the upper portion is disposed on the lower portion.~~

~~10. The method of claim 9, wherein producing the film stack further comprises:~~

~~sequentially depositing the polysilicon layers and the silicon oxide layers to produce the lower portion of the film stack;~~

~~removing the substrate comprising the lower portion of the film stack from the processing chamber;~~

~~exposing the processing chamber to a conditioning process;~~

~~placing the substrate comprising the lower portion of the film stack into the processing chamber; and then~~

~~sequentially depositing the polysilicon layers and the silicon oxide layers to produce the upper portion of the film stack.~~

~~11. The method of claim 10~~12. The method of claim 1, wherein the conditioning process comprises:

exposing the processing chamber to a conditioning plasma;
exposing the processing chamber to a purge gas; and then
evacuating the processing chamber,
wherein the processing chamber is at a pressure of about 5 Torr to about
50 Torr and is exposed to the purge gas having a flow rate of about 5
L/min to about 30 L/min.

~~12~~13. The method of claim 10~~1~~, wherein:

the processing chamber further comprises a faceplate disposed above the
substrate support;
the substrate support is disposed at a lower position separated from the
faceplate by a wide spacing during the conditioning process; and
the wide spacing is greater than 1,000 mils, as measured between the
substrate support and the faceplate.

~~13~~14. The method of claim 13, wherein the wide spacing is about 2,000 mils to about
10,000 mils.

15. The method of claim 1, wherein:

the processing chamber further comprises a faceplate disposed above the
substrate support;
the substrate support is disposed at an upper position separated from the
faceplate by a narrow spacing while depositing the polysilicon layers and
the silicon oxide layers; and
the narrow spacing is about 50 mils to 1,000 mils, as measured between
the substrate support and the faceplate.

~~14~~16. The method of claim 15, wherein the narrow spacing is about 100 mils to about
500 mils.

17. A method of forming a film stack with reduced defects, comprising:

- exposing a processing chamber to a conditioning plasma during a first conditioning process, wherein the processing chamber comprises a faceplate disposed above a substrate support;
- positioning a substrate on the substrate support within the processing chamber;
- moving the substrate support to an upper position separated from the faceplate by a narrow spacing, wherein the narrow spacing is about 50 mils to 1,000 mils, as measured between the substrate support and the faceplate;
- sequentially depositing polysilicon layers and silicon oxide layers to produce a lower portion of the film stack on the substrate;
- moving the substrate support containing the substrate to a lower position separated from the faceplate by a wide spacing, wherein the wide spacing is greater than 1,000 mils, as measured between the substrate support and the faceplate;
- maintaining a pressure of about 10 Torr to about 40 Torr within the processing chamber while moving the substrate support containing the substrate to the lower position;
- removing the substrate ~~comprising~~containing the lower portion of the film stack from the processing chamber;
- exposing the processing chamber to the conditioning plasma during a second conditioning process;
- positioning the substrate ~~comprising~~containing the lower portion of the film stack on the substrate support within the processing chamber;
- moving the substrate support to the upper position separated from the faceplate by the narrow spacing;
- sequentially depositing the polysilicon layers and the silicon oxide layers to produce an upper portion of the film stack on the ~~upper~~lower portion of the film stack within the processing chamber;
- moving the substrate support to the lower position separated from the faceplate by the wide spacing;
- removing the substrate ~~comprising~~containing the upper portion of the film stack

from the processing chamber; and

exposing the processing chamber to the conditioning plasma during a third conditioning process.

18. A method of forming a film stack with reduced defects, comprising:

exposing a processing chamber to a conditioning plasma at a power of about 100 watts to about 800 watts during a first conditioning process;

positioning a substrate on a substrate support within the processing chamber;

sequentially depositing polysilicon layers and silicon oxide layers to produce a lower portion of the film stack on the substrate, wherein depositing the polysilicon layers and the silicon oxide layers further comprises:

supplying a current of greater than 5 ampere (A) to a plasma profile modulator while generating a deposition plasma within the processing chamber;

exposing the substrate to the deposition plasma while depositing the polysilicon layers and the silicon oxide layers; and

maintaining the processing chamber at a pressure of greater than 2 Torr to about 100 Torr while depositing the polysilicon layers and the silicon oxide layers;

removing the substrate ~~comprising~~containing the lower portion of the film stack from the processing chamber;

exposing the processing chamber to the conditioning plasma at the power of about 100 watts to about 800 watts during a second conditioning process;

positioning the substrate ~~comprising~~containing the lower portion of the film stack on the substrate support within the processing chamber;

sequentially depositing the polysilicon layers and the silicon oxide layers to produce an upper portion of the film stack on the ~~upper~~lower portion of the film stack within the processing chamber, wherein depositing the polysilicon layers and the silicon oxide layers further comprises:

supplying the current of greater than 5 A to the plasma profile modulator while generating the deposition plasma within the processing

chamber;
exposing the substrate to the deposition plasma while depositing the polysilicon layers and the silicon oxide layers; and
maintaining the processing chamber at the pressure of greater than 2 Torr to about 100 Torr while depositing the polysilicon layers and the silicon oxide layers;
removing the substrate ~~comprising~~containing the upper portion of the film stack from the processing chamber; and
exposing the processing chamber to the conditioning plasma at the power of about 100 watts to about 800 watts during a third conditioning process.