CLAIMS

1. A semiconductor processing method comprising:

(a) generating a plasma from a deposition precursor in a processing region of a semiconductor processing chamber,

(i) wherein the plasma is initially struck and generated at a delivered power within a first period of time; and

(ii) wherein plasma power is delivered from a power source operating at a first duty cycle;

(b) transitioning the power source from the first duty cycle to a second duty cycle after the first period of time,

(i) wherein the first period of time is based on a time until the plasma becomes stable after being struck; and

(ii) wherein the plasma is determined to be stable when a plasma characteristic has a variation of 10% or less; and

(c) depositing a layer on a substrate in the processing region of the semiconductor processing chamber from the generated plasma, wherein the layer as deposited is characterized by a thickness of 50 Å or less,

(i) wherein the plasma is maintained for a second period of time at the second duty cycle; and

(ii) wherein the second period of time is longer than the first period of time.

2. The semiconductor processing method of claim 1, wherein the plasma power has an effective power of less than or equal to 4 Watts.

3. The semiconductor processing method of claim 1, wherein the first period of time is less than or equal to 2 seconds and the second period of time is greater than or equal to 2 seconds.

4. The semiconductor processing method of claim 1, wherein the first duty cycle is 20% or more.

5. The semiconductor processing method of claim 1, wherein the second duty cycle is 5% or less.

6. The semiconductor processing method of claim 1, wherein the plasma characteristic comprises a plasma forward power.

7. The semiconductor processing method of claim 1, wherein the plasma characteristic comprises a plasma reflected power.

8. The semiconductor processing method of claim 1, wherein the plasma characteristic comprises a plasma set-point power.

9. A semiconductor processing method comprising:

(a) generating a plasma from a deposition precursor in a processing region of a semiconductor processing chamber,

(i) wherein the plasma is initially struck and generated at a delivered power within a first period of time; and

(ii) wherein plasma power is delivered from a power source operating at a first peak power level that is less than or equal to 60 Watts;

(b) transitioning the power source from the first peak power level to a second peak power level after the first period of time,

(i) wherein the first period of time is based on a time until the plasma becomes stable after being struck; and

(ii) wherein the plasma is determined to be stable when a plasma characteristic has a variation of 10% or less; and

(c) depositing a layer on a substrate in the processing region of the semiconductor processing chamber from the generated plasma, wherein the layer as deposited is characterized by a thickness of 50 Å or less.

10. The semiconductor processing method of claim 9, wherein the first peak power level is greater than the second peak power level.

11. The semiconductor processing method of claim 9, wherein the plasma characteristic comprises a plasma ion density.

12. The semiconductor processing method of claim 9, wherein the plasma power is delivered at a plasma frequency pulsed at less than or equal to 10 kHz.

13. The semiconductor processing method of claim 9, wherein the plasma power has an effective power of less than or equal to 4 Watts.

14. The semiconductor processing method of claim 9, wherein the layer deposited on the substrate comprises an amorphous silicon layer.

15. A semiconductor processing method comprising:

(a) flowing a deposition precursor into a processing region of a semiconductor processing chamber;

(b) generating a deposition plasma of the deposition precursor, wherein the deposition plasma is initially struck with a first delivered power operating for a first period of time until the deposition plasma becomes stable after being struck,

(i) wherein the plasma is determined to be stable when a plasma characteristic has a variation of 10% or less; and

(ii) wherein the plasma is maintained with a second delivered power operating for a second period of time that is longer than the first period of time;

(c) depositing a layer on a substrate in the processing region of the semiconductor processing chamber from the generated plasma, wherein the layer as deposited is characterized by a thickness of 50 Å or less; and

(d) treating the layer as deposited with a treatment plasma, wherein the treatment plasma replaces the deposition plasma in the processing region of the semiconductor processing chamber.

16. The semiconductor processing method of claim 15, further comprising:

repeating the flowing, generating, depositing, and treating steps to gradually deposit a silicon-based film that is less than 50 Å.

17. The semiconductor processing method of claim 15, wherein the first delivered power has a duty cycle of more than or equal to 20%, and the second delivered power has a duty cycle of less than or equal to 5%.

18. The semiconductor processing method of claim 15, wherein the first delivered power has a power level that is greater than a power level for the second delivered power.

19. The semiconductor processing method of claim 15, wherein the deposition precursor comprises a silicon-containing precursor.

20. The semiconductor processing method of claim 15, wherein the treatment plasma is generated from a treatment precursor comprising helium.