

CLAIMS:

1. A semiconductor processing method comprising:
flowing a silicon-containing precursor into a processing region of a semiconductor processing chamber, wherein a substrate is housed within the processing region, and wherein the substrate is maintained at a temperature below or about 450 °C;
5 striking a plasma of the silicon-containing precursor; and
forming a layer of amorphous silicon on a semiconductor substrate, wherein the layer of amorphous silicon is characterized by less than or about 3% hydrogen incorporation.
2. The semiconductor processing method of claim 1, further comprising:
flowing hydrogen into the processing region of the semiconductor processing
10 chamber with the silicon-containing precursor.
3. The semiconductor processing method of claim 2, wherein the hydrogen is flowed at a flow rate of at least twice the flow rate of the silicon-containing precursor.
4. The semiconductor processing method of claim 1, further comprising:
flowing a boron-containing precursor or a phosphorus-containing precursor into the
15 processing region of the semiconductor processing chamber with the silicon-containing precursor.
5. The semiconductor processing method of claim 1, wherein the plasma is pulsed at a frequency of less than or about 10 kHz during the semiconductor processing method, and wherein a duty cycle of plasma pulsing is less than or about 50%.
6. The semiconductor processing method of claim 1, further comprising:
20 performing an energy treatment on the layer of amorphous silicon, wherein the energy treatment further reduces the hydrogen incorporation.
7. The semiconductor processing method of claim 6, wherein the energy treatment comprises exposing the layer of amorphous silicon to UV, microwave, or in situ plasma.
8. The semiconductor processing method of claim 6, wherein the energy
25 treatment is performed without breaking vacuum conditions during the semiconductor processing method.
9. A semiconductor processing method comprising:

flowing a silicon-containing precursor into a processing region of a semiconductor processing chamber, wherein a substrate is housed within the processing region, and wherein the substrate is maintained at a temperature below or about 450 °C;

- 5 flowing a catalytic precursor into the processing region of the semiconductor processing chamber;
 striking a plasma of the silicon-containing precursor and the catalytic precursor; and
 forming a layer of amorphous silicon on a semiconductor substrate, wherein the layer of amorphous silicon is characterized by less than or about 3% hydrogen incorporation.

- 10 10. The semiconductor processing method of claim 9, wherein the catalytic precursor comprises a boron-containing precursor, a phosphorus-containing precursor, or a silicon-and-halogen-containing precursor.

11. The semiconductor processing method of claim 10, wherein the halogen comprises fluorine, chlorine, or iodine.

- 15 12. The semiconductor processing method of claim 9, wherein the plasma is pulsed at a frequency of less than or about 10 kHz during the semiconductor processing method, and wherein a duty cycle of plasma pulsing is less than or about 50%.

13. The semiconductor processing method of claim 9, further comprising:
 performing an energy treatment on the layer of amorphous silicon, wherein the energy treatment further reduces the hydrogen incorporation.

- 20 14. The semiconductor processing method of claim 13, wherein the energy treatment comprises exposing the layer of amorphous silicon to UV, microwave, or in situ plasma.

- 15 15. A semiconductor processing method comprising:
 flowing a silicon-containing precursor into a processing region of a semiconductor processing chamber, wherein a substrate is housed within the processing region, and wherein the substrate is maintained at a temperature below or about 450 °C;
 striking a plasma of the silicon-containing precursor;
 forming a layer of amorphous silicon on a semiconductor substrate, wherein the layer of amorphous silicon is characterized by a first amount of hydrogen incorporation; and
30 performing an energy treatment on the layer of amorphous silicon, wherein the energy treatment reduces an amount of hydrogen from the layer of amorphous silicon to a second amount of hydrogen incorporation less than the first amount of hydrogen incorporation.

16. The semiconductor processing method of claim 15, wherein the energy treatment comprises exposing the layer of amorphous silicon to UV, microwave, or in situ plasma.
17. The semiconductor processing method of claim 15, wherein the second amount of hydrogen incorporation is less than or about 2 at. %.
- 5 18. The semiconductor processing method of claim 15, further comprising:
flowing hydrogen into the processing region of the semiconductor processing chamber with the silicon-containing precursor.
19. The semiconductor processing method of claim 18, wherein the hydrogen is flowed at a flow rate of at least twice the flow rate of the silicon-containing precursor.
- 10 20. The semiconductor processing method of claim 15, wherein the plasma is pulsed at a frequency of less than or about 10 kHz during the semiconductor processing method, and wherein a duty cycle of plasma pulsing is less than or about 50%.