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 equal to 450 °C;

flowing hydrogen into the processing region of the semiconductor processing chamber with the silicon-containing precursor, wherein a flow rate of the hydrogen compared to a flow rate of the silicon-containing precursor is greater than or equal to 20:1;

striking a plasma of the silicon-containing precursor; and

forming a layer of amorphous silicon on a semiconductor substrate, wherein the as-deposited layer of amorphous silicon is characterized by less than or equal to 3 at.% hydrogen incorporation.

2. The semiconductor processing method of claim 1, wherein the flow rate of the hydrogen compared to the flow rate of the silicon-containing precursor is greater than or equal to 50:1.

3. The semiconductor processing method of claim 1, further comprising:

flowing a boron-containing precursor or a phosphorus-containing precursor into the processing region of the semiconductor processing chamber with the silicon-containing precursor.

4. The semiconductor processing method of claim 1, wherein the plasma is pulsed at a frequency of less than or equal to 10 kHz during the semiconductor processing method, and wherein a duty cycle of plasma pulsing is less than or equal to 50%.

5. The semiconductor processing method of claim 1, further comprising:

performing an energy treatment on the layer of amorphous silicon, wherein the energy treatment further reduces the hydrogen incorporation.

6. The semiconductor processing method of claim 5, wherein the energy treatment comprises exposing the layer of amorphous silicon to UV, microwave, or in situ plasma.

7. The semiconductor processing method of claim 5, wherein the energy treatment is performed without breaking vacuum conditions during the semiconductor processing method.

8. 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 equal to 450 °C;

flowing hydrogen into the processing region of the semiconductor processing chamber with the silicon-containing precursor, wherein a flow rate of the hydrogen compared to a flow rate of the silicon-containing precursor is greater than or equal to 20:1;

striking a plasma of the silicon-containing precursor;

forming a layer of amorphous silicon on a semiconductor substrate, wherein the layer of amorphous silicon as-deposited is characterized by a first amount of hydrogen incorporation of less than or equal to 3 at.%; and

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.

9. The semiconductor processing method of claim 8, wherein the energy treatment comprises exposing the layer of amorphous silicon to UV, microwave, or in situ plasma.

10. The semiconductor processing method of claim 8, wherein the second amount of hydrogen incorporation is less than or equal to 2 at.%.

11. The semiconductor processing method of claim 8, wherein the hydrogen is flowed at a flow rate of at least twice the flow rate of the silicon-containing precursor.

12. The semiconductor processing method of claim 8, wherein the plasma is pulsed at a frequency of less than or equal to 10 kHz during the semiconductor processing method, and wherein a duty cycle of plasma pulsing is less than or equal to 50%.