CLAIMS:

1. A method of forming a semiconductor structure, the method comprising:

forming a silicon oxide layer from a silicon-containing precursor and an oxygen-containing precursor;

forming a silicon nitride layer from a silicon-containing precursor, a nitrogen-containing precursor, and an oxygen-containing precursor, wherein the silicon nitride layer is characterized by an oxygen concentration greater than 5 at.%, and wherein forming the silicon nitride layer comprises:

flowing the silicon-containing precursor and the nitrogen-containing precursor into a substrate processing region,

forming an amount of silicon nitride, and

adding the oxygen-containing precursor while continuing to form silicon nitride; and

repeating the forming a silicon oxide layer and the forming a silicon nitride layer to produce a stack of alternating layers of silicon oxide and silicon nitride.

2. The method of forming a semiconductor structure of claim 1, wherein the oxygen-containing precursor of the forming a silicon oxide layer and the oxygen-containing precursor of the forming a silicon nitride layer is the same precursor.

3. The method of forming a semiconductor structure of claim 1, wherein the stack of alternating layers comprises a first portion of the stack including the silicon oxide layer and the silicon nitride layer and a second portion of the stack overlying the first portion of the stack, and wherein producing the second portion of the stack comprises:

forming a silicon nitride layer from the silicon-containing precursor and the nitrogen-containing precursor, and an oxygen-containing precursor, wherein the silicon nitride layer is characterized by an oxygen concentration different from the oxygen concentration of the silicon nitride layer in the first portion of the stack.

4. The method of forming a semiconductor structure of claim 1, wherein the oxygen concentration of the silicon nitride layer is between 10 at.% and 30 at.%, and wherein a nitrogen atomic percent is greater than 30 at.%.

5. The method of forming a semiconductor structure of claim 1, wherein the oxygen-containing precursor is flowed at a constant flow rate, and wherein the silicon nitride layer formed comprises a bi-layer of silicon nitride substantially free of oxygen and silicon nitride characterized by an oxygen concentration greater than 5 at.%.

6. The method of forming a semiconductor structure of claim 1, wherein the oxygen-containing precursor is flowed at an increasing flow rate during the adding the oxygen-containing precursor, and wherein the silicon nitride layer formed comprises a gradient of oxygen concentration through the silicon nitride layer.

7. The method of forming a semiconductor structure of claim 1, further comprising forming one or more features through the stack of alternating layers of silicon oxide and silicon nitride, wherein a lateral removal of the silicon nitride layer at an interface of the silicon nitride layer and an overlying silicon oxide layer extends a distance less than 50% of a distance corresponding to a thickness of the silicon nitride layer.

8. A semiconductor structure comprising:

a stack of layers overlying a semiconductor substrate including:

a first portion of layers comprising alternating layers of a silicon oxide material and a silicon nitride material,

a second portion of layers overlying the first portion of layers, the second portion of layers comprising alternating layers of a silicon oxide material and a silicon nitride material,

a third portion of layers overlying the second portion of layers, the third portion of layers comprising alternating layers of a silicon oxide material and a silicon nitride material, and

one or more apertures formed through the stack of layers to the substrate, wherein a lateral notch in each individual layer of silicon nitride material at an interface of the individual layer of silicon nitride material and an overlying layer of silicon oxide material extends a distance

less than 100% of a distance corresponding to a thickness of the individual layer of silicon nitride material, and wherein the silicon nitride material of at least one of the first portion of layers, the second portion of layers and the third portion of layers is characterized by an oxygen concentration greater than 5 at.%.

9. The semiconductor structure of claim 8, wherein an oxygen concentration through the silicon nitride material of at least one of the first portion of layers, the second portion of layers, or the third portion of layers increases through a thickness of each of the layers of silicon nitride material in a direction towards the interface of the individual layer of silicon nitride material and the overlying layer of silicon oxide material.

10. The semiconductor structure of claim 8, wherein the refractive index of the silicon nitride of the second portion of layers is higher than the refractive index of the silicon nitride of the first portion of layers and the silicon nitride of the third portion of layers.

11. The semiconductor structure of claim 8, wherein the silicon nitride of the first portion of layers is characterized by a greater dopant concentration than the silicon nitride of the second portion of layers and the third portion of layers.

12. The semiconductor structure of claim 8, wherein the silicon nitride of the second portion of layers or the silicon nitride of the third portion of layers is characterized by a greater carbon concentration than the silicon nitride of the first portion of layers.

13. The semiconductor structure of claim 8, wherein the silicon nitride of the first portion of layers or the silicon nitride of the second portion of layers is characterized by a greater ratio of nitrogen to silicon than the silicon nitride of the third portion of layers.

14. A method of forming a semiconductor structure, the method comprising:

forming a first stack of alternating layers of a silicon oxide material and a silicon nitride material;

annealing the first stack of alternating layers of the silicon oxide material and the silicon nitride material, wherein the annealing reduces a hydrogen concentration of the silicon nitride material; and

forming a second stack of alternating layers of a silicon oxide material and a silicon nitride material, wherein the silicon nitride material is characterized by an oxygen concentration greater than 5 at.%.

15. The method of claim 14, wherein forming the silicon nitride layer of the first stack of alternating layers and/or the second stack of alternating layers comprises:

flowing the silicon-containing precursor and the nitrogen-containing precursor into a substrate processing region,

forming an amount of silicon nitride, and

adding the oxygen-containing precursor while continuing to form silicon nitride.