

What is claimed is:

1. A method of processing a substrate, comprising:
depositing a first piezoelectric material layer on the substrate in a first chamber, wherein the first piezoelectric material layer is formed on the substrate while the substrate is at a first temperature; and
depositing a second piezoelectric material layer on the first piezoelectric material layer after cooling the substrate to a second temperature, wherein the second temperature is lower than the first temperature, and the first piezoelectric material layer and the second piezoelectric material layer both comprise a first piezoelectric material.
2. The method of processing the substrate as recited in claim 1, wherein cooling the substrate to the second temperature occurs in a second chamber.
3. The method of processing the substrate as recited in claim 1, wherein cooling the first piezoelectric material layer and the substrate occur in a second chamber, wherein the first temperature is between about 120°C and about 600°C, and the second temperature is less than or equal to 100°C.
4. The method of processing the substrate as recited in claim 1, further comprising:
heating the substrate to greater than the first temperature in a second chamber;
establishing a distance between a surface of a target and a surface of the substrate before depositing the first piezoelectric material layer on the substrate by use of a physical vapor deposition process, the distance being between about 30 mm and 70 mm, and the target comprising a material selected from the group consisting of aluminum and scandium; and
maintaining a bias power between about 20 Watts (W) and about 50 W; and
maintaining a magnetic rotation speed between about 100 rpm and 150 rpm.
5. The method of processing the substrate as recited in claim 1, further comprising:

heating the substrate to greater than the first temperature in a second chamber, wherein depositing the second piezoelectric material layer occurs in the first chamber.

6. The method of processing the substrate as recited in claim 1, the method further comprising:

depositing a third piezoelectric material layer on top of the second piezoelectric material layer, wherein the third piezoelectric material layer comprises the first piezoelectric material layer, and the process of depositing the third piezoelectric material layer comprises depositing the third piezoelectric material layer at a different substrate bias than used while depositing the second piezoelectric material layer, wherein each of the first piezoelectric material layer, the second piezoelectric material layer, and the third piezoelectric material layer is formed by a physical vapor deposition process.

7. The method of processing the substrate as recited in claim 1, further comprising:

depositing a third piezoelectric material layer on top of the second piezoelectric material layer, wherein the third piezoelectric material layer comprises the first piezoelectric material layer, and the process of depositing the third piezoelectric material layer comprises depositing the third piezoelectric material layer at a different pressure or substrate bias than used to deposit the second piezoelectric material layer, wherein the process of depositing the first piezoelectric material layer, the second piezoelectric material layer, and the third piezoelectric material layer is performed by use of a physical vapor deposition process performed in the first chamber.

8. The method of processing the substrate as recited in claim 1, wherein the first piezoelectric material layer comprises aluminum and nitrogen, and the process of depositing the first piezoelectric material layer and the second piezoelectric material layer is performed by a physical vapor deposition process.

9. A method of processing a substrate in a cluster tool, comprising:

depositing a seed layer on a substrate in a first process chamber of the cluster tool by use of a physical vapor deposition process and at a first temperature, wherein the seed layer comprises a first material;

cooling the substrate to a second temperature, the second temperature below the first temperature; and

depositing a first piezoelectric material layer on the seed layer by use of the physical vapor deposition process, after cooling the substrate to the second temperature, and the first piezoelectric material layer comprises the first material.

10. The method of processing the substrate as recited in claim 9, wherein cooling the substrate to the second temperature occurs in a second chamber.

11. The method of processing the substrate as recited in claim 9, wherein cooling the substrate to a second temperature occurs in a second chamber, the first temperature is between about 120°C and about 600°C, and the second temperature is less than or equal to 100°C.

12. The method of processing the substrate as recited in claim 9, wherein depositing the seed layer on the substrate is performed by use of a physical vapor deposition process, and a target used in the physical vapor deposition process comprises aluminum and scandium.

13. The method of processing the substrate as recited in claim 9, wherein depositing the seed layer on the substrate further comprises:

maintaining a bias power between about 20 Watts (W) and about 50 W; and
maintaining a magnetic rotation speed between about 100 rpm and 150 rpm.

14. The method of processing the substrate as recited in claim 9, further comprising:

exposing a surface of the substrate to a plasma before depositing the seed layer; and

heating the substrate to a third temperature in a first process chamber of the cluster tool, wherein the first material comprises aluminum and nitrogen, and

the process of depositing the seed layer and the first piezoelectric material layer is performed by a physical vapor deposition process.

15. The method of processing the substrate as recited in claim 9, the method further comprises:

depositing a second piezoelectric material layer on top of the first piezoelectric material layer, wherein the second piezoelectric material layer comprises the first material, and the process of depositing the second piezoelectric material layer comprises depositing the second piezoelectric material layer at a different substrate bias than used while depositing the first piezoelectric material layer, wherein each of the seed layer, the first piezoelectric material layer, and the second piezoelectric material layer is formed by a physical vapor deposition process.

16. The method of processing the substrate as recited in claim 9, the method further comprises:

depositing a second piezoelectric material layer on top of the first piezoelectric material layer, wherein the second piezoelectric material layer comprises the first material, and the process of depositing the second piezoelectric material layer comprises depositing the second piezoelectric material layer at a different pressure or substrate bias than used to deposit the first piezoelectric material layer, wherein the process of depositing the seed layer and the first piezoelectric material layer is performed by use of a physical vapor deposition process performed, the first piezoelectric material layer deposited in a second chamber.

17. An apparatus for processing a substrate, comprising:

a processor coupled to at least one non-transitory computer readable medium, wherein the at least one non-transitory computer readable medium includes instructions which when executed by the processor are configured to perform a method comprising:

depositing a first piezoelectric material layer on the substrate in a first chamber, wherein the first piezoelectric material layer is formed on the substrate while the substrate is at a first temperature; and

depositing a second piezoelectric material layer on the first piezoelectric material layer after cooling the substrate to a second temperature, wherein the second temperature is lower than the first temperature, and the first piezoelectric material layer and the second piezoelectric material layer both comprise a first piezoelectric material.

18. The apparatus of claim 17, wherein the first temperature is between about 140 degrees Celsius and about 600 degrees Celsius, and the first piezoelectric material layer comprises scandium.

19. The apparatus of claim 17, wherein cooling the substrate to the second temperature occurs in a second chamber.

20. The apparatus of claim 17, wherein cooling the first piezoelectric material layer and the substrate occur in a second chamber, wherein the first temperature is between about 120°C and about 600°C, and the second temperature is less than or equal to 100°C.