

CLAIMS

What is claimed is:

1. A semiconductor device comprising:
a substrate;
a tensile layer overlying a major surface of the substrate; and
a compressive layer overlying the major surface;
wherein the tensile layer and the compressive layer both impart forces onto the substrate, to thereby keep the substrate from bowing.
2. The semiconductor device of claim 1,
further comprising an intermediate layer between the tensile layer and the compressive layer;
wherein the intermediate layer transmits stresses between the tensile layer and the compressive layer.
3. The semiconductor device of claim 2, wherein the intermediate layer is thinner than the compressive layer and the tensile layer.
4. The semiconductor device of claim 2, wherein the intermediate layer is an oxidized surface of the compressive layer or the tensile layer.
5. The semiconductor device of claim 1, or any of claims 1 to 4, wherein the tensile layer is closer than the compressive layer to the substrate.
6. The semiconductor device of claim 1, or any of claims 1 to 5,
wherein the tensile layer is a silicon nitride layer; and
wherein the compressive layer is a silicon oxide layer.

7. The semiconductor device of claim 6,
further comprising an intermediate layer between the tensile layer and the compressive layer;
wherein the intermediate layer is a silicon oxy-nitride layer.
8. The semiconductor device of claim 1, or any of claims 1 to 7, wherein a tensile force of the tensile layer balances out a compressive force of the compressive layer.
9. A method of making a semiconductor device, the method comprising:
depositing a tensile layer overlying a major face of a substrate of the device; and
depositing a compressive layer overlying the major face;
wherein the tensile layer and the compressive layer both impart forces onto the substrate, to thereby keep the substrate from bowing.
10. The method of claim 9, wherein depositing the tensile layer occurs before the depositing the compressive layer, with the compressive layer deposited overlying the tensile layer.
11. The method of claim 9, or of claim 9 or claim 10, further comprising forming an intermediate layer that is between the tensile layer and the compressive layer.
12. The method of claim 11, wherein the intermediate layer is formed after the depositing of the tensile layer, and before the depositing of the compressive layer.
13. The method of claim 12, wherein the intermediate layer is formed by oxidizing a surface of the tensile layer.
14. The method of claim 9, or any of claims 9 to 13, wherein depositing the tensile layer includes depositing silicon nitride.

15. The method of claim 14, wherein depositing the silicon nitride includes depositing the silicon nitride by physical vapor deposition.
16. The method of claim 14, wherein depositing the silicon nitride includes columnar deposition of the silicon nitride.
17. The method of claim 14, or any of claims 14 to 16, wherein forming the intermediate layer includes oxidizing a surface of the silicon nitride, to form silicon oxy-nitride.
18. The method of claim 17, wherein oxidizing includes exposing the surface of the silicon nitride to air.
19. The method of claim 17, or of claim 17 or claim 18, wherein depositing the compressive layer includes depositing silicon oxide on the silicon oxy-nitride.
20. The method of claim 19, wherein depositing the silicon oxide includes depositing the silicon oxide by physical vapor deposition.