

What is claimed is:

1. A substrate processing method comprising:
 - depositing a substantially conformal silicon film on a three dimensional structure formed on a substrate;
 - 5 exposing the substrate to a metal halide to form a capping layer comprising metal and halogen atoms;
 - annealing the substrate to diffuse halogen atoms below the capping layer and dope the three dimensional structure with halogen atoms; and
 - removing the capping layer from the substrate.
- 10 2. The method of claim 1, wherein the three dimensional structure comprises a FinFET structure.
3. The method of claim 1, wherein the three dimensional structure comprises a layered stack, the layered stack comprising a dielectric layer, a high-k layer and a nitride layer.
- 15 4. The method of claim 3, wherein the dielectric layer comprises silicon and oxygen.
- 20 5. The method of claim 3, wherein the high-k layer comprises Hf and O.
6. The method of claim 3, wherein the nitride layer comprises one or more of TiN, TiSiN, TaN, or TaSiN.
- 25 7. The method of claim 1, wherein depositing the silicon film comprises exposing the substrate to a silicon precursor, the silicon precursor comprising at least one species with a general formula of Si_xH_y , where x is an integer from 1 to 4 and y is $2x+2$.
- 30 8. The method of claim 7, wherein the substrate is maintained at a temperature in a range of about 400 °C to about 550 °C.
9. The method of claim 1, further comprising annealing the substrate after depositing the silicon film.

10. The method of claim 9, wherein the silicon film is annealed at a temperature in a range of about 500 °C to about 1000 °C for a period in a range of about 1 ms to about 10 s.
- 5 11. The method of claim 1, wherein the metal halide comprises W.
12. The method of claim 1, wherein the substrate is maintained at a temperature of about 100 °C to about 500 °C while the substrate is exposed to the metal halide.
- 10 13. The method of claim 1, wherein the capping layer further comprises silicon.
14. The method of claim 1, wherein the substrate is maintained at a temperature of about 200 °C to about 1000 °C while the substrate is annealed to diffuse halogen atoms below the capping layer.
- 15 15. The method of claim 3, wherein removing the capping layer comprises removing the capping layer and a portion of the nitride layer and reforming the nitride layer.
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