

Claims

1. A method comprising:
 exposing a substrate to a mixture of a silicon precursor and a halogen precursor to form an amorphous silicon film doped with halogen atoms; and
 annealing the amorphous silicon film doped with halogen atoms to drive the halogen atoms into the substrate,
 wherein the halogen precursor comprises a fluorine precursor, and the fluorine precursor comprises one or more of NX_3 , HX , SiX_4 , cyclic polymeric halosilanes $((\text{SiX}_2)_n$ where n is greater than or equal to 3), a compound with the general formula $\text{Si}_n\text{HX}_{2n+1}$, a compound with the general formula $\text{Si}_n\text{H}_2\text{X}_{2n}$ or a compound with the general formula $\text{Si}_n\text{X}_m\text{H}_{2n+2-m}$, where X is fluorine and m is in the range of 1 to $2n+2$.
2. The method of claim 1, wherein the substrate comprises a FinFET device.
3. The method of claim 1, wherein the silicon precursor comprises one or more of a silane ($\text{Si}_n\text{H}_{2n+2}$), halosilanes (SiX_4), cyclic polymeric halosilanes $((\text{SiX}_2)_n$ where n is greater than or equal to 3), a compound with the general formula $\text{Si}_n\text{HX}_{2n+1}$, or a compound with the general formula $\text{Si}_n\text{H}_2\text{X}_{2n}$, where X is a halogen selected from one or more of fluorine, chlorine, bromine and/or iodine.
4. The method of claim 1, wherein the silicon precursor and the fluorine precursor are the same compound.
5. The method of claim 1, wherein the mixture further comprises a molecular halogen.
6. The method of claim 1, wherein the annealing process is a rapid thermal annealing process.
7. The method of claim 6, wherein the rapid thermal annealing process is a spike annealing process performed at a temperature of between about 700 °C and about 1100 °C.

8. The method of claim 7, wherein the spike annealing process comprises a laser spike anneal.
9. The method of claim 1, further comprising removing the amorphous silicon film from the substrate after annealing.
10. The method of claim 9, further comprising depositing a film on the substrate after removing the amorphous silicon film.
11. A substrate processing method, comprising:
depositing a conformal halogen doped silicon film on a three dimensional structure formed on a substrate, wherein the three dimensional structure is a FinFET device;
and
annealing the conformal halogen doped silicon film to diffuse the halogen into the three dimensional structure to dope the FinFET device with halogen atoms.
12. The method of claim 11, wherein depositing the conformal halogen doped film comprises exposing the three dimensional structure to a silicon and halogen containing precursor.
13. The method of claim 12, wherein depositing the conformal halogen doped film further comprises exposing the three dimensional structure to a molecular halogen.
14. The method of claim 11, wherein the annealing process is a rapid thermal annealing process.