

THE CLAIMS

What is claimed is:

1. A method of ion implantation, comprising:

flowing a carbon dopant source composition to an ion implanter configured for carbon doping of a substrate; and

operating the ion implanter to generate carbon dopant species from the carbon dopant source composition and to implant the carbon dopant species in the substrate,

wherein the carbon dopant source composition comprises at least one carbon dopant source material selected from the group consisting of:

CO; CO₂; CF₄; CH₄; COF₂; CH₂O; C₂F₄H₂; C₂H₆; compounds of the formula C_xF_wO_yH_zCl_vN_u, wherein x is greater than or equal to 1, w is greater than or equal to 0, y is greater than or equal to 0, z is greater than or equal to 0, v is greater than or equal to 0, and u is greater than or equal to 0, with the proviso that at least one of w, y, z, v, and u has a non-zero value; hydrocarbons; alkanes; cyclic alkanes; alkenes; cyclic alkenes; polyenes; cyclic polyenes; alkynes; cyclic alkynes; arenes, and their derivatives; partially and fully halogenated hydrocarbons; alcohols of general formula ROH, wherein R is an organo moiety; halogenated alcohols; aldehydes; ethers; halogenated ethers; esters; halogenated esters; primary amines; secondary amines; tertiary amines; halogenated amines; N-halogenated amines; nitro (RNO₂) and nitroso (RNO) alkyl and halogenated alkyl compounds; halides, wherein the number of carbon atoms is 1; halides containing two carbon atoms; and halides and hydrides containing multiple carbon atoms; and wherein the carbon dopant source material optionally is co-flowed to the ion implanter with at least one co-flow gas or is flowed to the ion implanter in mixture with at least one additional gas, wherein said at least one co-flow gas or at least one additional gas is selected from the group consisting of H₂, PH₃, AsH₃, CH₄, GeH₄, SiH₄, NH₃, F₂, XeF₂, BF₃, SF₆, GeF₄, SiF₄, NF₃, N₂F₄, HF, WF₆, MoF₆, Ar, Ne, Kr, Xe, He, N₂, O₂, O₃, H₂O₂, H₂O, Cl₂, HCl, COF₂, CH₂O, C₂F₄H₂, PF₃, PF₅, CF₄, CF₃H, CF₂H₂, CFH₃, B₂F₄, compounds of the formula X_yF_z wherein X is any element in stoichiometric ratio with F, y ≥ 1, and z ≥ 1, compounds of the formula C_aO_xH_yF_z wherein a ≥ 0, x ≥ 0, y ≥ 0 and z ≥ 1, compounds of the formula C_xF_yH_z wherein x ≥ 0, y > 0, and z ≥ 0, and fluorine-containing gases.

2. The method of claim 1, wherein the carbon dopant source material is co-flowed to the ion implanter with at least one co-flow gas selected from the group consisting of H_2 , PH_3 , AsH_3 , CH_4 , GeH_4 , SiH_4 , NH_3 , N_2F_4 , F_2 , XeF_2 , BF_3 , SF_6 , GeF_4 , SiF_4 , NF_3 , HF , WF_6 , MoF_6 , Ar, Ne, Kr, Xe, He, N_2 , O_2 , O_3 , H_2O_2 , H_2O , Cl_2 , HCl , COF_2 , CH_2O , $C_2F_4H_2$, PF_3 , PF_5 , CF_4 , CF_3H , CF_2H_2 , CFH_3 , B_2F_4 , compounds of the formula X_yF_z wherein X is any element in stoichiometric ratio with F, $y \geq 1$, and $z \geq 1$, compounds of the formula $C_aO_xH_yF_z$ wherein $a \geq 0$, $x \geq 0$, $y \geq 0$ and $z \geq 1$, compounds of the formula $C_xF_yH_z$ wherein $x \geq 0$, $y > 0$, and $z \geq 0$, and fluorine-containing gases.

3. The method of claim 1, wherein the carbon dopant source material is flowed to the ion implanter in mixture with at least one additional gas selected from the group consisting of H_2 , PH_3 , AsH_3 , CH_4 , GeH_4 , SiH_4 , NH_3 , N_2F_4 , F_2 , XeF_2 , BF_3 , SF_6 , GeF_4 , SiF_4 , NF_3 , HF , WF_6 , MoF_6 , Ar, Ne, Kr, Xe, He, N_2 , O_2 , O_3 , H_2O_2 , H_2O , Cl_2 , HCl , COF_2 , CH_2O , $C_2F_4H_2$, PF_3 , PF_5 , CF_4 , CF_3H , CF_2H_2 , CFH_3 , B_2F_4 , compounds of the formula X_yF_z wherein X is any element in stoichiometric ratio with F, $y \geq 1$, and $z \geq 1$, compounds of the formula $C_aO_xH_yF_z$ wherein $a \geq 0$, $x \geq 0$, $y \geq 0$ and $z \geq 1$, compounds of the formula $C_xF_yH_z$ wherein $x \geq 0$, $y > 0$, and $z \geq 0$, and fluorine-containing gases.

4. The method of claim 1, wherein the carbon dopant source material comprises CO or CO_2 , and is co-flowed to the ion implanter with at least one co-flow gas selected the group consisting of H_2 , PH_3 , AsH_3 , CH_4 , GeH_4 , SiH_4 , NH_3 , N_2F_4 , F_2 , XeF_2 , BF_3 , SF_6 , GeF_4 , SiF_4 , NF_3 , HF , WF_6 , MoF_6 , Ar, Ne, Kr, Xe, He, N_2 , O_2 , O_3 , H_2O_2 , H_2O , Cl_2 , HCl , COF_2 , CH_2O , $C_2F_4H_2$, PF_3 , PF_5 , CF_4 , CF_3H , CF_2H_2 , CFH_3 , B_2F_4 , compounds of the formula X_yF_z wherein X is any element in stoichiometric ratio with F, $y \geq 1$, and $z \geq 1$, compounds of the formula $C_aO_xH_yF_z$ wherein $a \geq 0$, $x \geq 0$, $y \geq 0$ and $z \geq 1$, compounds of the formula $C_xF_yH_z$ wherein $x \geq 0$, $y > 0$, and $z \geq 0$, and fluorine-containing gases.

5. The method of claim 1, wherein the carbon dopant source material comprises a gas selected from the group consisting of CO, CO_2 , CF_4 , CH_4 , COF_2 , CH_2O , and $C_2F_4H_2$ in mixture or co-flow with a gas selected from the group consisting of H_2 , PH_3 , AsH_3 , SF_6 , CH_4 , GeH_4 , SiH_4 , F_2 , XeF_2 , BF_3 , GeF_4 , CF_4 , SiF_4 , Ar, Kr, Xe, He, Cl_2 , COF_2 , CH_2O , $C_2F_4H_2$, PF_3 , PF_5 , and fluorine-containing gases.

6. The method of claim 1, wherein the carbon dopant source material is co-flowed to the ion implanter with a co-flow gas, wherein the carbon dopant source material and co-flow gas combination is selected from the group consisting of the following combinations:

CO + H₂
CO + H₂ + XeF₂
CO + CH₄
CO + COF₂
CO + COF₂ + O₂ + H₂
CO + BF₃
CO + PH₃
CO + SF₆
CO + SiF₄
CO₂ + H₂
CO₂ + H₂ + XeF₂
CO₂ + CH₄
CO₂ + COF₂
CO₂ + COF₂ + O₂ + H₂
CO₂ + BF₃
CO₂ + PH₃
CO₂ + SF₆
CO₂ + SiF₄
C_xH_y + O₂
C_xH_y + F₂
C_xH_y + noble gas
COF₂ + H₂

wherein x and y have any appropriate stoichiometric values.

7. The method of claim 1, wherein the substrate is selected from the group consisting of semiconductor substrates, flat-panel display substrates, LED substrates, and solar panel substrates.

8. The method of claim 1, as carried out in the manufacture of a semiconductor article, flat-panel display article, LED article, LED display article, or solar panel article.

9. The method of claim 1, wherein the carbon dopant source material is flowed to the ion implanter in mixture with a cleaning gas.

10. The method of claim 9, wherein the carbon dopant source material comprises CO.

11. The method of claim 9, wherein the cleaning gas comprises fluorine or COF₂.

12. The method of claim 9, wherein the cleaning gas comprises an oxygen-containing gas.
13. The method of claim 9, wherein the cleaning gas comprises a fluorine-containing gas.
14. The method of claim 1, further comprising cleaning the ion implanter with a cleaning gas.
15. The method of claim 14, wherein the cleaning gas comprises fluorine or COF_2 .
16. The method of claim 1, wherein carbon dopant source material is co-flowed to the ion implanter with at least one co-flow gas or is flowed to the ion implanter in mixture with at least one additional gas, thereby enhancing operational character of said ion implanter in at least one of recipe transition, beam stability, source life, beam uniformity, beam current, and cost of ownership, relative to corresponding operation of said ion implanter without any said co-flow gas or additional gas.
17. A method of cluster or molecular implantation of carbon in a substrate, using a carbon dopant selected from the group consisting of carbon ion, C_x^+ , wherein x is greater than 1, and ions of the formula $\text{C}_x\text{F}_w\text{O}_y\text{H}_z\text{Cl}_v\text{N}_u^+$ wherein x is greater than or equal to 1, and wherein the value of each of w , y , z , v , and u is 0 or higher, but wherein at least one is non-zero.
18. An ion implantation process, comprising:
generating carbon dopant species by ionization of a carbon dopant source composition; and
implanting the carbon dopant species in a substrate,
wherein the carbon dopant source composition comprises carbon dopant source material selected from the group consisting of:

 CO ; CO_2 ; CF_4 ; CH_4 ; COF_2 ; CH_2O ; $\text{C}_2\text{F}_4\text{H}_2$; C_2H_6 ; compounds of the formula $\text{C}_x\text{F}_w\text{O}_y\text{H}_z\text{Cl}_v\text{N}_u$, wherein x is greater than or equal to 1, w is greater than or equal to 0, y is greater than or equal to 0, z is greater than or equal to 0, v is greater than or equal to 0, and u is greater than or equal to 0, with the proviso that at least one of w , y , z , v , and u has a non-zero value; hydrocarbons; alkanes; cyclic alkanes; alkenes; cyclic alkenes; polyenes; cyclic polyenes; alkynes; cyclic alkynes; arenes, and their derivatives; partially and fully halogenated hydrocarbons; alcohols of general formula ROH , wherein R is an organo moiety; halogenated alcohols; aldehydes; ethers; halogenated

ethers; esters; halogenated esters; primary amines; secondary amines; tertiary amines; halogenated amines; N-halogenated amines; nitro (RNO_2) and nitroso (RNO) alkyl and halogenated alkyl compounds; halides, wherein the number of carbon atoms is 1; halides containing two carbon atoms; and halides and hydrides containing multiple carbon atoms; and

wherein the carbon dopant source material is flowed to the generating with at least one co-flow gas or in mixture with at least one additional gas, wherein said at least one co-flow gas or at least one additional gas is selected from the group consisting of H_2 , PH_3 , AsH_3 , CH_4 , GeH_4 , SiH_4 , NH_3 , F_2 , XeF_2 , BF_3 , SF_6 , GeF_4 , SiF_4 , NF_3 , HF , WF_6 , MoF_6 , Ar , Ne , Kr , Xe , He , N_2 , O_2 , O_3 , H_2O_2 , H_2O , Cl_2 , F_2 , HCl , COF_2 , CH_2O , $\text{C}_2\text{F}_4\text{H}_2$, PF_3 , PF_5 , PF , CF_4 , CF_3H , CF_2H_2 , CFH_3 , B_2F_4 , compounds of the formula X_yF_z wherein X is any element in stoichiometric ratio with F, $y \geq 1$, and $z \geq 1$, compounds of the formula $\text{C}_a\text{O}_x\text{H}_y\text{F}_z$ wherein $a \geq 0$, $x \geq 0$, $y \geq 0$ and $z \geq 1$, compounds of the formula $\text{C}_x\text{F}_y\text{H}_z$ wherein $x \geq 0$, $y > 0$, and $z \geq 0$, and fluorine-containing gases.

19. An ion implantation system, comprising:

an ion implanter configured to receive carbon dopant source material, generate carbon dopant species therefrom, and implant the carbon dopant species in a substrate; and
a supply assembly arranged to deliver carbon dopant source material to the ion implanter, wherein the supply assembly comprises carbon dopant source material selected from the group consisting of:

CO ; CO_2 ; CF_4 ; CH_4 ; COF_2 ; CH_2O ; $\text{C}_2\text{F}_4\text{H}_2$; C_2H_6 ; compounds of the formula $\text{C}_x\text{F}_w\text{O}_y\text{H}_z\text{Cl}_v\text{N}_u$, wherein x is greater than or equal to 1, w is greater than or equal to 0, y is greater than or equal to 0, z is greater than or equal to 0, v is greater than or equal to 0, and u is greater than or equal to 0, with the proviso that at least one of w, y, z, v, and u has a non-zero value; hydrocarbons; alkanes; cyclic alkanes; alkenes; cyclic alkenes; polyenes; cyclic polyenes; alkynes; cyclic alkynes; arenes, and their derivatives; partially and fully halogenated hydrocarbons; alcohols of general formula ROH , wherein R is an organo moiety; halogenated alcohols; aldehydes; ethers; halogenated ethers; esters; halogenated esters; primary amines; secondary amines; tertiary amines; halogenated amines; N-halogenated amines; nitro (RNO_2) and nitroso (RNO) alkyl and halogenated alkyl compounds; halides, wherein the number of carbon atoms is 1; halides containing two carbon atoms; and halides and hydrides containing multiple carbon atoms; and

wherein the carbon dopant source material is flowed to the ion implanter with at least one co-flow gas or in mixture with at least one additional gas, wherein said at least one co-flow gas or at least one additional gas is selected from the group consisting of H_2 , PH_3 , AsH_3 , CH_4 , GeH_4 , SiH_4 , NH_3 , F_2 , XeF_2 , BF_3 , SF_6 , GeF_4 , SiF_4 , NF_3 , HF , WF_6 , MoF_6 , Ar , Ne , Kr , Xe , He , N_2 , O_2 , O_3 , H_2O_2 , H_2O , Cl_2 , F_2 , HCl , COF_2 , CH_2O , $C_2F_4H_2$, PF_3 , PF_5 , PF , CF_4 , CF_3H , CF_2H_2 , CFH_3 , B_2F_4 , compounds of the formula X_yF_z wherein X is any element in stoichiometric ratio with F , $y \geq 1$, and $z \geq 1$, compounds of the formula $C_aO_xH_yF_z$ wherein $a \geq 0$, $x \geq 0$, $y \geq 0$ and $z \geq 1$, compounds of the formula $C_xF_yH_z$ wherein $x \geq 0$, $y > 0$, and $z \geq 0$, and fluorine-containing gases.

20. A gas combination composition comprising (A) one or more carbon dopant source gas(es) selected from the group consisting of CO ; CO_2 ; CF_4 ; CH_4 ; COF_2 ; CH_2O ; $C_2F_4H_2$; C_2H_6 ; compounds of the formula $C_xF_wO_yH_zCl_vN_u$, wherein x is greater than or equal to 1, w is greater than or equal to 0, y is greater than or equal to 0, z is greater than or equal to 0, v is greater than or equal to 0, and u is greater than or equal to 0, with the proviso that at least one of w , y , z , v , and u has a non-zero value; hydrocarbons; alkanes; cyclic alkanes; alkenes; cyclic alkenes; polyenes; cyclic polyenes; alkynes; cyclic alkynes; arenes, and their derivatives; partially and fully halogenated hydrocarbons; alcohols of general formula ROH , wherein R is an organo moiety; halogenated alcohols; aldehydes; ethers; halogenated ethers; esters; halogenated esters; primary amines; secondary amines; tertiary amines; halogenated amines; N-halogenated amines; nitro (RNO_2) and nitroso (RNO) alkyl and halogenated alkyl compounds; halides, wherein the number of carbon atoms is 1; halides containing two carbon atoms; and halides and hydrides containing multiple carbon atoms; and at least one additional gas selected from the group consisting of (B) one or more fluorocompound gas(es), (C) one or more noble gases, (D) one or more oxide gases, and (E) other gases selected from the group consisting of N_2 and H_2 .

21. A gas combination composition according to claim 20, comprising (A) one or more carbon dopant source gas(es) and (B) one or more fluorocompound gas(es), wherein the carbon dopant source gas(es) (A) is/are selected from the group consisting of CO , CO_2 , COF_2 , and $C_aO_xH_yF_z$ wherein $a \geq 1$, $x \geq 0$, $y \geq 0$ and $z \geq 0$, and the fluorocompound gas(es) (B) is/are selected from the group consisting of F_2 , COF_2 , CF_4 , MoF_6 , B_2F_4 , NF_3 , N_2F_4 , XeF_2 , BF_3 , SF_6 , GeF_4 , SiF_4 , WF_6 , compounds of the formula X_yF_z wherein X is any element in stoichiometric ratio with F , $y \geq 1$, and $z \geq 1$, compounds of the formula $C_aO_xH_yF_z$ wherein $a \geq 0$, $x \geq 0$, $y \geq 0$ and $z \geq 1$, and compounds of the formula $C_xF_yH_z$ wherein $x \geq 0$, $y > 0$, and $z \geq 0$.

22. The gas combination composition of claim 21, comprising at least one and up to 10 gases from group (A), and at least one and up to ten gases from group (B).

23. The gas combination composition of claim 21, wherein each of the group (A) gas(es) and group (B) gas(es) has a concentration in a range of from 0.001 % by volume to 99.999% by volume, based on total volume of the group (A) and group (B) gases, with the volume percentages of all group (A) gases and group (B) gases in the composition totaling to 100 volume %.

24. The gas combination composition of claim 21, wherein the relative proportion of the group (B) gas(es) in the combination composition of group (A) gases and group (B) gases is from 0.001% to 20% by volume, based on total volume of the group (A) and group (B) gases, with the volume percentages of all group (A) gases and group (B) gases in the composition totaling to 100 volume %.

25. The gas combination composition of claim 24, wherein the group (B) gas(es) comprise NF_3 .

26. The gas combination composition of claim 25, wherein NF_3 is present at concentration of 0.5%-15% by volume, based on total volume of the group (A) and group (B) gases, with the volume percentages of all group (A) gases and group (B) gases in the composition totaling to 100 volume %.

27. A method of ion implantation of carbon in a substrate, comprising carbon doping the substrate using a gas combination composition as claimed in any one of claims 20-26.

28. The method of claim 27, wherein the substrate comprises a semiconductor substrate, solar panel substrate, LED substrate, or flat panel substrate.

29. A method of improving beam current in a carbon ion implantation process, wherein carbon dopant source material is delivered to the ion implantation process in mixture and/or co-flow relationship with one or more fluorocompound gas(es) selected from the group consisting of F_2 , COF_2 , CF_4 , MoF_6 , B_2F_4 , NF_3 , N_2F_4 , XeF_2 , BF_3 , SF_6 , GeF_4 , SiF_4 , WF_6 , compounds of the formula X_yF_z wherein X is any element in stoichiometric ratio with F, $y \geq 1$, and $z \geq 1$, compounds of the

formula $C_aO_xH_yF_z$ wherein $a \geq 0$, $x \geq 0$, $y \geq 0$ and $z \geq 1$, and compounds of the formula $C_xF_yH_z$ wherein $x \geq 0$, $y > 0$, and $z \geq 0$.

30. The method of claim 29, wherein the fluorocompound gas(es) comprise NF_3 .

31. An ion implantation system, comprising:

an ion implanter configured to receive carbon dopant source material, generate carbon dopant species therefrom, and implant the carbon dopant species in a substrate; and

a supply assembly arranged to deliver carbon dopant source material to the ion implanter, wherein the carbon dopant source material is in mixture with or in co-flow relationship to one or more fluorocompound gas(es) selected from the group consisting of F_2 , COF_2 , CF_4 , MoF_6 , B_2F_4 , NF_3 , N_2F_4 , XeF_2 , BF_3 , SF_6 , GeF_4 , SiF_4 , WF_6 , compounds of the formula X_yF_z wherein X is any element in stoichiometric ratio with F, $y \geq 1$, and $z \geq 1$, and compounds of the formula $C_aO_xH_yF_z$ wherein $a \geq 0$, $x \geq 0$, $y \geq 0$ and $z \geq 1$, and compounds of the formula $C_xF_yH_z$ wherein $x \geq 0$, $y > 0$, and $z \geq 0$.

32. The ion implantation system of claim 31, wherein the carbon dopant source material comprises one or more gas(es) selected from the group consisting of CO , CO_2 , COF_2 , and $C_aO_xH_yF_z$ wherein $a \geq 1$, $x \geq 0$, $y \geq 0$ and $z \geq 0$.

33. The ion implantation system of claim 31, wherein the fluorocompound gas(es) comprises NF_3 .

34. The ion implantation system of claim 31, wherein the fluorocompound gas(es) comprises CF_4 .

35. The ion implantation system of claim 31, wherein the fluorocompound gas(es) comprises CFH_3 .

36. The ion implantation system of claim 31, wherein the carbon dopant source material comprises CO_2 .

37. The ion implantation system of claim 31, wherein the carbon dopant source material comprises COF_2 .

THE CLAIMS

What is claimed is:

1. A gas combination composition comprising (A) one or more carbon dopant source gas(es) and (B) one or more fluorocompound gas(es), wherein the carbon dopant source gas(es) is/are selected from the group consisting of CO, CO₂, COF₂, and C_aO_xH_yF_z wherein $a \geq 1$, $x \geq 0$, $y \geq 0$ and $z \geq 0$, wherein the fluorocompound gas(es) comprises NF₃, and wherein the relative proportion of the group (B) gas(es) in the combination composition of group (A) gases and group (B) gases is from 0.001% to 20% by volume, based on total volume of the group (A) and group (B) gases, with the volume percentages of all group (A) gases and group (B) gases in the composition totaling to 100 volume %.
2. The gas combination composition of claim 1, comprising at least one and up to 10 gases from group (A), and at least one and up to ten gases from group (B).
3. The gas combination composition of claim 1, wherein NF₃ is present at concentration of 0.5%-15% by volume, based on total volume of the group (A) and group (B) gases, with the volume percentages of all group (A) gases and group (B) gases in the composition totaling to 100 volume %.
4. A method of improving beam current in a carbon ion implantation process, wherein carbon dopant source material is delivered to the ion implantation process in mixture and/or co-flow relationship with one or more fluorocompound gas(es), wherein the fluorocompound gas(es) comprises NF₃.
5. The method of claim 4, wherein the carbon dopant source material comprises one or more gas(es) selected from the group consisting of CO, CO₂, COF₂, and C_aO_xH_yF_z wherein $a \geq 1$, $x \geq 0$, $y \geq 0$ and $z \geq 0$.
6. The method of claim 4, wherein the carbon dopant source material comprises CO₂.
7. The method of claim 4, wherein the carbon dopant source material comprises COF₂.

8. An ion implantation system, comprising:

an ion implanter configured to receive carbon dopant source material, generate carbon dopant species therefrom, and implant the carbon dopant species in a substrate; and

a supply assembly arranged to deliver carbon dopant source material to the ion implanter, wherein the carbon dopant source material is in mixture with or in co-flow relationship to one or more fluorocompound gas(es), wherein the fluorocompound gas(es) comprises NF_3 .

9. The ion implantation system of claim 8, wherein the carbon dopant source material comprises one or more gas(es) selected from the group consisting of CO , CO_2 , COF_2 , and $\text{C}_a\text{O}_x\text{H}_y\text{F}_z$ wherein $a \geq 1$, $x \geq 0$, $y \geq 0$ and $z \geq 0$.

10. The ion implantation system of claim 8, wherein the carbon dopant source material comprises CO_2 .

11. The ion implantation system of claim 8, wherein the carbon dopant source material comprises COF_2 .

12. An ion implantation system, comprising:

an ion implanter configured to receive carbon dopant source material, generate carbon dopant species therefrom, and implant the carbon dopant species in a substrate; and

a supply assembly arranged to deliver carbon dopant source material to the ion implanter, wherein the carbon dopant source material is in mixture with or in co-flow relationship to one or more fluorocompound gas(es), wherein the fluorocompound gas(es) comprises CF_4 .

13. The ion implantation system of claim 12, wherein the carbon dopant source material comprises one or more gas(es) selected from the group consisting of CO , CO_2 , COF_2 , and $\text{C}_a\text{O}_x\text{H}_y\text{F}_z$ wherein $a \geq 1$, $x \geq 0$, $y \geq 0$ and $z \geq 0$.

14. The ion implantation system of claim 12, wherein the carbon dopant source material comprises CO_2 .

15. The ion implantation system of claim 12, wherein the carbon dopant source material comprises COF_2 .

16. An ion implantation system, comprising:

an ion implanter configured to receive carbon dopant source material, generate carbon dopant species therefrom, and implant the carbon dopant species in a substrate; and

a supply assembly arranged to deliver carbon dopant source material to the ion implanter, wherein the carbon dopant source material is in mixture with or in co-flow relationship to one or more fluorocompound gas(es), wherein the fluorocompound gas(es) comprises CFH_3 .

17. The ion implantation system of claim 16, wherein the carbon dopant source material comprises one or more gas(es) selected from the group consisting of CO , CO_2 , COF_2 , and $\text{C}_a\text{O}_x\text{H}_y\text{F}_z$ wherein $a \geq 1$, $x \geq 0$, $y \geq 0$ and $z \geq 0$.

18. The ion implantation system of claim 16, wherein the carbon dopant source material comprises CO_2 .

19. The ion implantation system of claim 16, wherein the carbon dopant source material comprises COF_2 .