Claims

1. A method for storing and delivering aluminum-containing dopant material, comprising:

selecting the aluminum-containing dopant material represented by the formula $Al_xR_yL_z$, where R is a methyl group, L is a halogen selected from the group consisting of Cl, F, I and Br and x can be either 1 or 2, whereby if x = 1, then y = 1 or 2 and if x = 2 then y = 2-4, and z = 3x – y for x =1 or x = 2;

storing the aluminum-containing dopant material in a storage and delivery container, said material being chemically stable therein;

withdrawing the material in a vapor phase from the storage and delivery container;

flowing the vaporized material at a predetermined flow rate in the absence of heat traced lines extending between said container and said chamber; and

introducing said vaporized material to an ion source chamber.

2. The method of claim 1, wherein said flow rate is between about .1 – 50 sccm.

3. The method of claim 1, wherein said material is withdrawn from the container in response to a pressure in the chamber being 760 torr or less.

4. The method of claim 1, wherein said material is stored as a liquid at 20-25°C having a vapor pressure greater than 2 torr.

5. The method of claim 1, wherein said aluminum-containing dopant material is selected from the group consisting of (Al(CH3)2Cl), (Al(CH3)Cl2), (Al2(CH3)3Cl3) $Al(CH_3)_2Cl$, $Al(CH_3)Cl2$, $Al_2(CH_3)_3Cl_3$, $Al(CH_3)_2F$, $Al(CH_3)F2$, $Al(CH_3)Br2$ and $Al(CH_3)_2Br$.

6. The method of claim 1, further comprising:

ionizing said material in said chamber;

generating aluminum-containing ions;

reducing formation of deposits in comparison to deposits formed by alkyl aluminum material not having a halogen, and whereby the alkyl group of the alkyl aluminum material contains two or more carbon-containing groups.

7. The method of claim 1, wherein said material is stored at sub-atmospheric conditions below 760 Torr.

8. The method of claim 1, wherein said material is stored and withdrawn without the addition of thermal energy.

9. The method of claim 1, further comprising introducing a diluents gas into the chamber.

10. A sub-atmospheric storage and delivery package for a dopant gas composition comprising:

aluminum-containing dopant material represented by the formula $Al_xR_yL_z$, where R is a methyl group, L is a halogen selected from the group consisting of Cl, F, I and Br and x can be either 1 or 2, whereby if x = 1, then y = 1 or 2 and if x = 2 then y = 2-4; and z = 3x - y; and

a cylinder for holding the aluminum-containing dopant material in at least partial vapor phase under sub-atmospheric conditions, said vapor pressure greater than about 2 Torr; and

a dual port valve assembly in mechanical communication with the cylinder, the dual port valve comprising a fill port valve and a discharge port valve, wherein the fill port valve is in fluid communication with an interior of the cylinder to introduce the aluminum-containing dopant material therein, and the discharge port valve is in fluid communication with a flow discharge path

extending from the interior to the exterior of the cylinder to discharge the aluminum-containing dopant material therefrom; and

a check valve located along said flow discharge path, said check valve configured to move from a closed position to an open position in response to a sub-atmospheric condition external to the cylinder.

11. The sub-atmospheric storage and delivery package of claim 10, wherein a vacuum-actuated valve element is disposed along the discharge path, said delivery device actuated to allow a controlled flow of the aluminum-containing dopant material from the interior volume of the device in response to a sub-atmospheric condition achieved along the discharge flow path.

12. The sub-atmospheric storage and delivery package of claim 10, wherein the aluminum-containing dopant material is selected from the group consisting of (Al(CH3)2Cl), (Al(CH3)Cl2), (Al2(CH3)3Cl3) $Al(CH_3)_2Cl$, $Al(CH_3)Cl2$, $Al_2(CH_3)_3Cl_3$, $Al(CH_3)_2F$, $Al(CH_3)F2$, $Al(CH_3)Br2$ and $Al(CH_3)_2Br$.

13. The sub-atmospheric storage and delivery package of claim 10 in combination with a beamline ion implant system, said package being operably connected to said system by conduit extending therebetween, wherein said conduit is characterized by an absence of heat tracing.

14. The sub-atmospheric storage and delivery package of claim 10 in combination with a plasma immersion ion implant system, said package being operably connected to said system by conduit extending therebetween, wherein said conduit is characterized by an absence of heat tracing.

15. The sub-atmospheric storage and delivery package of claim 10, wherein said check valve disposed within the interior of the cylinder.

16. The sub-atmospheric storage and delivery package of claim 10, wherein said check valve is disposed within the exterior of the cylinder.

17. The sub-atmospheric storage and delivery package of claim 13, wherein said material is held in the cylinder as a liquid at about 20-25°C having a vapor pressure greater than about 2 torr.

18. A composition for implanting aluminum ions, comprising:

aluminum-containing dopant material represented by the formula $Al_xR_yL_z$, where R is a methyl group, L is a halogen selected from the group consisting of Cl, F, I and Br and x can be either 1 or 2, whereby if x = 1, then y = 1 or 2 and if x = 2 then y = 2-4, and z = 3x – y for x =1 or x = 2,

wherein said aluminum-containing dopant material is adapted to produce aluminum ions to be deposited into a substrate with a substantial reduction in carbon deposition in comparison to conventional aluminum-containing dopant compositions.

19. The composition of claim 18, wherein said composition further comprises an inert gas, non-inert gas or any combination thereof, and whereby R contains two or more methyl groups.

20. The composition of claim 17, wherein said aluminum-containing dopant material is selected from the group consisting of (Al(CH3)2Cl), (Al(CH3)Cl2), (Al2(CH3)3Cl3) $Al(CH_3)_2Cl$, $Al(CH_3)Cl2$, $Al_2(CH_3)_3Cl_3$, $Al(CH_3)_2F$, $Al(CH_3)F2$, $Al(CH_3)Br2$ and $Al(CH_3)_2Br$.

CLAIMS:

1. A sub-atmospheric storage and delivery package for a dopant gas composition comprising:

aluminum-containing dopant material represented by the formula $Al_xR_yL_z$, where R is a methyl group, L is a halogen selected from the group consisting of Cl, F, I and Br and x can be either 1 or 2, whereby if x = 1, then y = 1 or 2 and if x = 2 then y = 2-4; and z = 3x - y; and

a cylinder for holding the aluminum-containing dopant material in at least partial vapor phase under sub-atmospheric conditions, said vapor pressure greater than 2 Torr; and

a dual port valve assembly in mechanical communication with the cylinder, the dual port valve comprising a fill port valve and a discharge port valve, wherein the fill port valve is in fluid communication with an interior of the cylinder to introduce the aluminum-containing dopant material therein, and the discharge port valve is in fluid communication with a flow discharge path extending from the interior to the exterior of the cylinder to discharge the aluminum-containing dopant material therefrom; and

a check valve located along said flow discharge path, said check valve configured to move from a closed position to an open position in response to a sub-atmospheric condition external to the cylinder.

2. The sub-atmospheric storage and delivery package of claim 1, wherein a vacuum-actuated valve element is disposed along the flow discharge path, said delivery device actuated to allow a controlled flow of the aluminum-containing dopant material from the interior volume of the device in response to the sub-atmospheric condition achieved along the discharge flow path.

3. The sub-atmospheric storage and delivery package of claim 1, wherein the aluminum-containing dopant material is selected from the group consisting of

(Al(CH3)2Cl), (Al(CH3)Cl2), (Al2(CH3)3Cl3) $Al(CH_3)_2Cl$, $Al(CH_3)Cl2$, $Al_2(CH_3)_3Cl_3$, $Al(CH_3)_2F$, $Al(CH_3)F2$, $Al(CH_3)Br2$ and $Al(CH_3)_2Br$.

4. The sub-atmospheric storage and delivery package of claim 1 in combination with a beamline ion implant system, said delivery package being operably connected to said system by conduit extending therebetween, wherein said conduit is characterized by an absence of heat tracing.

5. The sub-atmospheric storage and delivery package of claim 1 in combination with a plasma immersion ion implant system, said delivery package being operably connected to said system by conduit extending therebetween, wherein said conduit is characterized by an absence of heat tracing.

6. The sub-atmospheric storage and delivery package of claim 1, wherein said check valve disposed within the interior of the cylinder.

7. The sub-atmospheric storage and delivery package of claim 1, wherein said check valve is disposed within the exterior of the cylinder.

8. The sub-atmospheric storage and delivery package of claim 4, wherein said aluminum-containing dopant material is held in the cylinder as a liquid at 20-25°C having a vapor pressure greater than 2 torr.

9. The sub-atmospheric storage and delivery package of claim 1, wherein said aluminum-containing dopant material is adapted to produce aluminum ions to be deposited into a substrate with a substantial reduction in carbon deposition in comparison to conventional aluminum-containing dopant compositions.

10. The sub-atmospheric storage and delivery package of claim 1, wherein said composition further comprises an inert gas, non-inert gas or any combination thereof, and whereby R contains two or more methyl groups.

11. The sub-atmospheric storage and delivery package of claim 1, wherein said aluminum-containing dopant material is stored at the sub-atmospheric conditions below 760 Torr.

12. The sub-atmospheric storage and delivery package of claim 1, wherein said aluminum-containing dopant material in the package is configured to be stored and withdrawn without the addition of thermal energy.

13. The sub-atmospheric storage and delivery package of claim 1, further comprising a diluents gas package in combination with said sub-atmospheric storage and delivery package.

14. The sub-atmospheric storage and delivery package of claim 1, wherein said delivery package is configured to dispense said aluminum-containing dopant material at a flow rate that is between .1 – 50 sccm.

15. The sub-atmospheric storage and delivery package of claim 1, wherein said delivery package is in flow communication with an ionization chamber.

16. The sub-atmospheric storage and delivery package of claim 15, wherein said delivery package is configured to withdraw said aluminum-containing dopant material from the package in response to a pressure in the ionization chamber being 760 torr or less.

17. The sub-atmospheric storage and delivery of claim 1, wherein said aluminum-containing dopant material is stored as a liquid at 20-25°C having a vapor pressure greater than 2 torr.