Claims:

1. A method of generating aluminum ion in an ion source having an ion source chamber, the method comprising:

in an ion source chamber that contains aluminum dopant source, flowing into the ion source chamber:

fluorine-containing gas selected from BF_3, PF_3, PF_5, GeF_4, XeF_2, CF_4 B_2F_4, SiF_4, Si_2F_6, AsF_3, AsF_5, XeF_4, XeF_6, WF_6, MoF_6, C_nF_{2n+2}, C_nF_{2n}, C_nF_{2n-2}, $C_nH_xF_{2n+2-x}$, $C_nH_xF_{2n-x}$, $C_nH_xF_{2n-2-x}$ (n =1, 2, 3 . . ., -x = 0, 1, 2 . . .), COF_2, SF_6, SF_4, SeF_6, NF_3, N_2F_4, HF, F_2, or a combination thereof, and

hydrogen-containing gas, and

generating aluminum ions within the ion source chamber.

2. The method of claim 1 wherein the aluminum dopant source comprises solid aluminum target selected from: aluminum oxide, aluminum nitride, aluminum carbide, aluminum boride, and a combination of these.

3. The method of claim 1 wherein hydrogen-containing gas and fluorine-containing gas are flowed into the ion source chamber in relative amounts of from 2 to 60 percent (volume) hydrogen-containing gas based on total hydrogen-containing and fluorine-containing gas.

4. The method of claim 1 wherein hydrogen-containing gas and fluorine-containing gas are flowed into the ion source chamber in relative amounts of from 5 to 60 percent (volume) hydrogen-containing gas based on total hydrogen-containing and fluorine-containing gas.

5. The method of claim 1 wherein the flow of hydrogen-containing gas to the ion source as a co-gas extends an operating life of the ion source by at least 10 percent relative to an operating life that would result from comparable operation of the ion source without the hydrogen-containing gas.

6. The method of claim 1 wherein the flow of hydrogen-containing gas to the ion source as a co-gas reduces glitching of the ion source by at least 20 percent relative to an amount of

glitching that would result from comparable operation of the ion source without the hydrogen-containing gas.

7. The method of claim 1 wherein within a range of from greater than 0 to 60 percent hydrogen-containing gas, a maximum beam current occurs, and wherein the hydrogen-containing gas is flowed in an amount that is within 60 percentage points of the maximum beam current.

8. The method of claim 1 comprising generating neutral or ionized fluorine-containing species from the fluorine-containing gas, and reacting the fluorine-containing species with the aluminum target to generate aluminum ion.

9. The method of claim 1 wherein the ion source chamber comprises:

an interior defined by interior surfaces that include sidewalls, a bottom, and a top, and

a cathode and an anti-cathode at the interior,

wherein an interior surface comprises tungsten or molybdenum.

~~10. The method of claim 9 wherein:~~

~~during generating the aluminum ions, non-aluminum ions are also generated, the non-aluminum ions comprising tungsten ion (W^+) or molybdenum (Mo^+), tungsten or molybdenum fluoride ion (WF_x^+, MoF_x^+) (x = 1, 2, 3, 4, or 5), or both, and~~

~~the hydrogen-containing gas reduces an amount of the tungsten ion (W^+) or molybdenum (Mo+), tungsten or molybdenum fluoride ion (WF_x^+, MoF_x^+), or both, that are generated.~~

~~11~~10. The method of claim 1 wherein:

the fluorine-containing gas is PF_3, PF_5, or GeF_4, and

the hydrogen-containing gas is H_2.

~~12~~11. The method of claim 1 wherein:

the fluorine-containing gas is PF_5, and

the hydrogen-containing gas is H_2.

~~13~~12. The method of claim 1 wherein the hydrogen-containing gas is selected from H_2, PH_3, AsH_3, SiH_4, B_2H_6, CH_4, NH_3, GeH_4, or A_xH_y (A is any element except H, x, y = 1, 2, 3, 4, 5, 6, 7, 8, 8 or 10) and a combination thereof.

~~14~~13. A method of forming aluminum ion in an ion source chamber, the method comprising:

flowing fluorine-containing gas selected from PF_3 and PF_5 into an ion source chamber that contains aluminum dopant source, and

generating aluminum ion within the ion source chamber.

~~15~~14. The method of claim ~~14~~13 wherein the aluminum dopant source comprises solid aluminum target selected from: aluminum oxide, aluminum nitride, aluminum carbide, aluminum boride, and a combination thereof.

~~16. The method of claim 14 comprising flowing hydrogen-containing gas into the ion source chamber.~~

~~17. The method of claim 16 wherein the hydrogen-containing gas is selected from: H_2, PH_3, AsH_3, SiH_4, B_2H_6, CH_4, NH_3, GeH_4, A_xH_y (A is any element except H, x, y = 1, 2, 3, 4, 5, 6, 7, 8, 8 or 10), and a combination thereof.~~

~~18. The method of claim 16 comprising flowing PF_5 and the hydrogen-containing gas into the ion source chamber in relative amounts of from 2 to 60 percent (volume) hydrogen-containing gas based on total hydrogen-containing gas and fluorine-containing gas.~~

~~19. The method of claim 16 comprising flowing PF_3 and the hydrogen-containing gas into the ion source chamber in relative amounts of from 2 to 60 percent (volume) hydrogen-containing gas based on total hydrogen-containing gas and fluorine-containing gas.~~

~~20. The method of claim 14 comprising: generating neutral or ionized fluorine-containing species from the fluorine-containing gas, and reacting the fluorine-containing species with the aluminum dopant source to generate aluminum ion.~~