

Claims

1. A method for implanting selenium, comprising:
 - selecting an enriched selenium-based dopant precursor material, said material having a plurality of selenium mass isotopes;
 - selecting a specific selenium mass isotope from the plurality of selenium mass isotopes, said specific selenium mass isotope contained in the precursor material at an enrichment level above natural abundance levels;
 - providing the enriched selenium-based dopant precursor material in a storage and delivery container, said container being compatible with the selected enriched selenium-based dopant precursor;
 - withdrawing the enriched selenium-based dopant precursor material in a gaseous phase from the storage and delivery container;
 - flowing the material at a predetermined flow to an ion source;
 - ionizing the enriched selenium-based dopant precursor material to produce ions of the specific selenium mass isotope;
 - extracting the ionized specific selenium mass isotope from the ion source;
 - implanting the ionized specific selenium mass isotope into a substrate;
 - wherein the specific selenium mass isotope is enriched to a concentration greater than a concentration of the specific selenium mass isotope in a corresponding natural abundance selenium dopant precursor material, thereby allowing the predetermined flow rate of the enriched selenium-based dopant precursor material to be less than a corresponding flow rate of a natural abundance selenium-based dopant precursor material.
2. The method of claim 1, wherein the enriched selenium-based dopant precursor is selected from the group consisting of metallic selenium, selenium oxide, selenium hexafluoride, hydrogen selenide and combinations thereof.
3. The method of claim 2, wherein the enriched selenium-based dopant precursor is hydrogen selenide.

4. The method of claim 1, wherein the predetermined flow rate of the enriched selenium-based dopant precursor is less than a flow rate of a non-enriched selenium compound.
5. The method of claim 3, wherein the enriched hydrogen selenide comprises mass 80 selenium isotope is in an enriched concentration greater than naturally occurring levels.
6. The method of claim 1, wherein the enriched selenium-based dopant precursor material is enriched in the specific selenium mass isotope at least 10% above natural abundance levels.
7. The method of claim 1, wherein the enrichment level is 50% above natural abundance levels.
8. The method of claim 2, wherein the enriched selenium-based dopant precursor material is selenium hexafluoride enriched in one of the selenium isotopes at about 10% or greater.
9. The method of claim 8, wherein the enriched selenium hexafluoride is flowed to the ion source with a diluent, said diluent being co-flowed or sequentially flowed with the enriched selenium-based dopant precursor material.
10. The method of claim 8, further comprising withdrawing the enriched selenium hexafluoride from the storage and delivery container, wherein said container is a sub-atmospheric delivery dispensing system.
11. The method of claim 8, wherein a halide-containing dopant gas is introduced into the ion source chamber after implanting the ionized specific selenium mass isotope from the enriched selenium hexafluoride.

12. The method of claim 9, wherein the diluent comprises a hydride.
13. A source supply for a selenium-based dopant gas composition comprising:
gaseous selenium dopant containing gas source material enriched in one of its naturally occurring mass isotopes; and
a sub-atmospheric delivery and storage device for maintaining the enriched selenium dopant containing gas source material in a pressurized state within an interior volume of the device, said delivery device in fluid communication with a discharge flow path, wherein said delivery device is actuated to allow a controlled flow of the enriched selenium dopant containing gas source material from the interior volume of the device in response to a sub-atmospheric condition achieved along the discharge flow path.
14. The source supply of claim 13 where the selenium dopant gas source is enriched selenium hexafluoride.
15. The source supply of claim 13, further comprising a diluent or tracer gas premixed with the selenium dopant containing gas in the sub-atmospheric delivery and storage device.
16. The source supply of claim 15, further comprising a diluent wherein said diluent gas is selected from the group consisting of H₂, Xe, Ar, Kr, Ne, N₂, PH₃ and mixtures thereof.
17. The source supply of claim 15, further comprising a tracer gas selected from the group consisting of phosphine, hydrogen, arsine, germane and silane.
18. The source supply of claim 13, further comprising a secondary sub-atmospheric storage and delivery device, said secondary sub-atmospheric storage and delivery device comprising a diluent or tracer gas.

19. A selenium-containing dopant composition for use in an ion implantation process, comprising:

a selenium-containing dopant gas source material enriched in one of its naturally occurring mass isotopes to a concentration greater than a concentration of the specific selenium mass isotope in a corresponding natural abundance selenium dopant precursor material, wherein said selenium-containing material is stored and delivered in the gas phase, thereby characterized by an absence of storage and delivery from a vaporizer.

20. The selenium-containing dopant composition of claim 19, selected from the group consisting of metallic selenium, selenium oxide, selenium hexafluoride, hydrogen selenide and combinations thereof.

21. The selenium-containing dopant composition of claim 19, comprising selenium hexafluoride.

22. The selenium-containing dopant composition of claim 21, further comprising a tracer or diluent material.

Claims

1. A method for implanting selenium, comprising:
 - selecting an enriched selenium-based dopant precursor material, said material having a plurality of selenium mass isotopes;
 - selecting a specific selenium mass isotope from the plurality of selenium mass isotopes, said specific selenium mass isotope contained in the precursor material at an enrichment level above natural abundance levels;
 - providing the enriched selenium-based dopant precursor material in a storage and delivery container, said container being compatible with the selected enriched selenium-based dopant precursor;
 - withdrawing the enriched selenium-based dopant precursor material in a gaseous phase from the storage and delivery container;
 - flowing the material at a predetermined flow to an ion source;
 - ionizing the enriched selenium-based dopant precursor material to produce ions of the specific selenium mass isotope;
 - extracting the ionized specific selenium mass isotope from the ion source;
 - implanting the ionized specific selenium mass isotope into a substrate;
 - wherein the specific selenium mass isotope is enriched to a concentration greater than a concentration of the specific selenium mass isotope in a corresponding natural abundance selenium dopant precursor material, thereby allowing the predetermined flow rate of the enriched selenium-based dopant precursor material to be less than a corresponding flow rate of a natural abundance selenium-based dopant precursor material.
2. The method of claim 1, wherein the enriched selenium-based dopant precursor is selected from the group consisting of metallic selenium, selenium oxide, selenium hexafluoride, hydrogen selenide and combinations thereof.
3. The method of claim 2, wherein the enriched selenium-based dopant precursor is hydrogen selenide.

4. The method of claim 1, wherein the predetermined flow rate of the enriched selenium-based dopant precursor is less than a flow rate of a non-enriched selenium compound.
5. The method of claim 3, wherein the enriched hydrogen selenide comprises mass 80 selenium isotope is in an enriched concentration greater than naturally occurring levels.
6. The method of claim 1, wherein the enriched selenium-based dopant precursor material is enriched in the specific selenium mass isotope at least 10% above natural abundance levels.
7. The method of claim 1, wherein the enrichment level is 50% above natural abundance levels.
8. The method of claim 2, wherein the enriched selenium-based dopant precursor material is selenium hexafluoride enriched in one of the selenium isotopes at about 10% or greater.
9. The method of claim 8, wherein the enriched selenium hexafluoride is flowed to the ion source with a diluent, said diluent being co-flowed or sequentially flowed with the enriched selenium-based dopant precursor material.
10. The method of claim 8, further comprising withdrawing the enriched selenium hexafluoride from the storage and delivery container, wherein said container is a sub-atmospheric delivery dispensing system.
11. The method of claim 8, wherein a halide-containing dopant gas is introduced into the ion source chamber after implanting the ionized specific selenium mass isotope from the enriched selenium hexafluoride.

12. The method of claim 9, wherein the diluent comprises a hydride.
13. A source supply for a selenium-based dopant gas composition comprising:
gaseous selenium dopant containing gas source material enriched in one of its naturally occurring mass isotopes; and
a sub-atmospheric delivery and storage device for maintaining the enriched selenium dopant containing gas source material in a pressurized state within an interior volume of the device, said delivery device in fluid communication with a discharge flow path, wherein said delivery device is actuated to allow a controlled flow of the enriched selenium dopant containing gas source material from the interior volume of the device in response to a sub-atmospheric condition achieved along the discharge flow path.
14. The source supply of claim 13 where the selenium dopant gas source is enriched selenium hexafluoride.
15. The source supply of claim 13, further comprising a diluent or tracer gas premixed with the selenium dopant containing gas in the sub-atmospheric delivery and storage device.
16. The source supply of claim 15, further comprising a diluent wherein said diluent gas is selected from the group consisting of H₂, Xe, Ar, Kr, Ne, N₂, PH₃ and mixtures thereof.
17. The source supply of claim 15, further comprising a tracer gas selected from the group consisting of phosphine, hydrogen, arsine, germane and silane.
18. The source supply of claim 13, further comprising a secondary sub-atmospheric storage and delivery device, said secondary sub-atmospheric storage and delivery device comprising a diluent or tracer gas.

19. A selenium-containing dopant composition for use in an ion implantation process, comprising:

a selenium-containing dopant gas source material enriched in one of its naturally occurring mass isotopes to a concentration greater than a concentration of the specific selenium mass isotope in a corresponding natural abundance selenium dopant precursor material, wherein said selenium-containing material is stored and delivered in the gas phase, thereby characterized by an absence of storage and delivery from a vaporizer.

20. The selenium-containing dopant composition of claim 19, selected from the group consisting of metallic selenium, selenium oxide, selenium hexafluoride, hydrogen selenide and combinations thereof.

21. The selenium-containing dopant composition of claim 19, comprising selenium hexafluoride.

22. The selenium-containing dopant composition of claim 21, further comprising a tracer or diluent material.