

Claims

1. A dopant gas composition comprising:
a silicon-based dopant gas composition comprising a first silicon-based species and a second species, wherein said second species is selected to have a ionization cross-section higher than that of the first silicon-based species at an operating arc voltage of an ion source utilized during generation and implantation of active silicon ions;
wherein said silicon-based dopant gas composition improves the ion beam current so as to maintain or increase beam current without degradation of said ion source in comparison to a beam current generated from silicon tetrafluoride (SiF₄).
2. The dopant gas composition of claim 1, wherein said first silicon-based species is selected from the group consisting of SiH₂Cl₂, Si₂H₆, SiH₄, SiF₂H₂, SiF₄ and any combination thereof.
3. The dopant composition of claim 1, wherein said first silicon-based species is SiF₄.
4. The dopant composition of claim 1, wherein said first silicon-based species is SiF₄ and the second species is disilane (Si₂H₆).
5. The dopant composition of claim 4, wherein said Si₂H₆ has a concentration of less than 50% based on the overall volume of said composition.
6. The dopant composition of claim 5, wherein said Si₂H₆ has a concentration of about 10% or less.

7. A system for providing an improved beam current during silicon ion implantation, comprising:

an ion source apparatus partially defined by an arc chamber wall, wherein the chamber comprises a silicon ion source disposed at least partially within the chamber wall;

one or more supply vessels in fluid communication with said ion source apparatus, said vessels storing a silicon-based dopant gas composition, said composition comprising a first silicon-based species and a second species, wherein said second species is selected to have an ionization cross-section higher than that of the first silicon-based species at an operating arc voltage of the ion source during implantation of active silicon ions;

one or more supply feed lines corresponding to the one or more supply vessels, said feed lines extending from the one or more supply vessels through the wall into the chamber;

wherein said one or more vessels are configured to dispense said silicon-based dopant composition through said supply feed lines and into said ion source apparatus thereby allowing the silicon ion source to ionize the silicon-based dopant gas composition to generate at least a portion of the active silicon ions from at least said first silicon-based species, the active silicon ions producing an increased beam current in comparison to a beam current generated solely from SiF₄.

8. The system of claim 7, wherein said first silicon-based species is selected from the group consisting of SiH₂Cl₂, Si₂H₆, SiH₄ SiF₂H₂, SiF₄ and any combination thereof.

9. The system of claim 7 wherein said first silicon-based species is SiF₄ and said second species is a silicon-based species, said silicon-based species comprising Si₂H₆.

10. The system of claim 9, wherein said Si_2H_6 is at a concentration of 1-10 vol% based on the overall silicon-based dopant composition.
11. The system of claim 7, wherein a first supply vessel and a second supply vessel are provided as part of a gas kit, said first supply vessel comprising SiF_4 and said second supply vessel comprising Si_2H_6 , each of said first and second supply vessel dispensing SiF_4 and Si_2H_6 , respectively, to the ion source chamber at controlled flow rates to produce a silicon-containing dopant composition within the chamber comprising SiF_4 and Si_2H_6 at a predetermined concentration whereby the concentration of Si_2H_6 is less than about 20 vol%.
12. The system of claim 11, wherein said kit comprises a first flow controller for regulating flow of SiF_4 at a first flow rate from a first supply vessel, and said kit further comprises a second flow controller for regulating flow of Si_2H_6 at a second flow rate from a second supply vessel.
13. The system of claim 7, wherein a single supply vessel is pre-mixed with the silicon-based dopant gas composition, further wherein said supply vessel is a sub-atmospheric storage and delivery vessel.
14. The system of claim 9, wherein the Si_2H_6 is in an amount of between 2.5 vol% to 5 vol% based on the overall volume of said composition.

15. A method for increasing beam current during silicon ion implantation, comprising:

selecting a first silicon-based species;

selecting a second species having an ionization cross-section higher than that of the first silicon-based species at a predetermined operating arc voltage of an ion source to be utilized during generation and implantation of active silicon ions;

providing the first silicon-based and the second species in one or more supply vessels;

flowing the first silicon-based species and the second species from the one or more supply vessels into an ion source apparatus;

ionizing the first silicon-based species;

generating active silicon ions; and

producing an increased beam current in comparison to a beam current generated solely from SiF₄, wherein said increased beam current extends source life in comparison to a beam current generated solely from SiF₄.

16. The method of claim 15, wherein said second species is a silicon-containing species, said first and second silicon-containing species selected from the group consisting of SiH₂Cl₂, Si₂H₆, SiH₄, SiF₂H₂, SiF₄ and any combination thereof.

17. The method of claim 15, wherein said first silicon-based species is SiF₄ and the second species is a silicon-based species comprising Si₂H₆ ranging between about 2.5 vol% to about 5 vol% based on the overall composition in the ion source apparatus.

18. The method of claim 15, wherein a first supply vessel and a second supply vessel are provided as part of a gas kit, said first supply vessel comprising SiF₄ and said second supply vessel comprising Si₂H₆, each of said first and second supply vessel dispensing SiF₄ and Si₂H₆, respectively, to the ion source chamber at controlled flow rates in a co-flowed or sequentially flowed manner to produce a silicon-containing dopant composition within the chamber comprising SiF₄ and Si₂H₆ at a predetermined concentration whereby the concentration of Si₂H₆ is greater than about 1 vol% and less than about 10 vol% based on a volume of the overall composition.

19. The method of claim 15, wherein said predetermined operating arc voltage ranges from about 80 V – 120 V.

20. The method of claim 15, wherein a single supply vessel dispenses a concentration comprising about 10 vol% or lower of Si₂H₆ and the balance SiF₄.

CLAIMS

1. A dopant gas composition comprising:
a silicon-based dopant gas composition comprising a first silicon-based species and a second species, wherein said second species is selected to have a ionization cross-section higher than that of the first silicon-based species at an operating arc voltage of an ion source utilized during generation and implantation of active silicon ions;
wherein said silicon-based dopant gas composition improves the ion beam current so as to maintain or increase beam current without degradation of said ion source in comparison to a beam current generated from silicon tetrafluoride (SiF₄).
2. The dopant gas composition of claim 1, wherein said first silicon-based species is selected from the group consisting of SiH₂Cl₂, Si₂H₆, SiH₄, SiF₂H₂, SiF₄ and any combination thereof.
3. The dopant composition of claim 1, wherein said first silicon-based species is SiF₄.
4. The dopant composition of claim 1, wherein said first silicon-based species is SiF₄ and the second species is disilane (Si₂H₆).
5. The dopant composition of claim 4, wherein said Si₂H₆ has a concentration of less than 50% based on the overall volume of said composition.
6. The dopant composition of claim 5, wherein said Si₂H₆ has a concentration of about 10% or less.

7. A system for providing an improved beam current during silicon ion implantation, comprising:

an ion source apparatus partially defined by an arc chamber wall, wherein the chamber comprises a silicon ion source disposed at least partially within the chamber wall;

one or more supply vessels in fluid communication with said ion source apparatus, said vessels storing a silicon-based dopant gas composition, said composition comprising a first silicon-based species and a second species, wherein said second species is selected to have an ionization cross-section higher than that of the first silicon-based species at an operating arc voltage of the ion source during implantation of active silicon ions;

one or more supply feed lines corresponding to the one or more supply vessels, said feed lines extending from the one or more supply vessels through the wall into the chamber;

wherein said one or more vessels are configured to dispense said silicon-based dopant composition through said supply feed lines and into said ion source apparatus thereby allowing the silicon ion source to ionize the silicon-based dopant gas composition to generate at least a portion of the active silicon ions from at least said first silicon-based species, the active silicon ions producing an increased beam current in comparison to a beam current generated solely from SiF₄.

8. The system of claim 7, wherein said first silicon-based species is selected from the group consisting of SiH₂Cl₂, Si₂H₆, SiH₄, SiF₂H₂, SiF₄ and any combination thereof.

9. The system of claim 7 wherein said first silicon-based species is SiF₄ and said second species is a silicon-based species, said silicon-based species comprising Si₂H₆.

10. The system of claim 9, wherein said Si_2H_6 is at a concentration of 1-10 vol% based on the overall silicon-based dopant composition.
11. The system of claim 7, wherein a first supply vessel and a second supply vessel are provided as part of a gas kit, said first supply vessel comprising SiF_4 and said second supply vessel comprising Si_2H_6 , each of said first and second supply vessel dispensing SiF_4 and Si_2H_6 , respectively, to the ion source chamber at controlled flow rates to produce a silicon-containing dopant composition within the chamber comprising SiF_4 and Si_2H_6 at a predetermined concentration whereby the concentration of Si_2H_6 is less than about 20 vol%.
12. The system of claim 11, wherein said kit comprises a first flow controller for regulating flow of SiF_4 at a first flow rate from a first supply vessel, and said kit further comprises a second flow controller for regulating flow of Si_2H_6 at a second flow rate from a second supply vessel.
13. The system of claim 7, wherein a single supply vessel is pre-mixed with the silicon-based dopant gas composition, further wherein said supply vessel is a sub-atmospheric storage and delivery vessel.
14. The system of claim 9, wherein the Si_2H_6 is in an amount of between 2.5 vol% to 5 vol% based on the overall volume of said composition.

15. A method for increasing beam current during silicon ion implantation, comprising:

selecting a first silicon-based species;

selecting a second species having an ionization cross-section higher than that of the first silicon-based species at a predetermined operating arc voltage of an ion source to be utilized during generation and implantation of active silicon ions;

providing the first silicon-based and the second species in one or more supply vessels;

flowing the first silicon-based species and the second species from the one or more supply vessels into an ion source apparatus;

ionizing the first silicon-based species;

generating active silicon ions; and

producing an increased beam current in comparison to a beam current generated solely from SiF₄, wherein said increased beam current extends source life in comparison to a beam current generated solely from SiF₄.

16. The method of claim 15, wherein said second species is a silicon-containing species, said first and second silicon-containing species selected from the group consisting of SiH₂Cl₂, Si₂H₆, SiH₄, SiF₂H₂, SiF₄ and any combination thereof.

17. The method of claim 15, wherein said first silicon-based species is SiF₄ and the second species is a silicon-based species comprising Si₂H₆ ranging between about 2.5 vol% to about 5 vol% based on the overall composition in the ion source apparatus.

18. The method of claim 15, wherein a first supply vessel and a second supply vessel are provided as part of a gas kit, said first supply vessel comprising SiF₄ and said second supply vessel comprising Si₂H₆, each of said first and second supply vessel dispensing SiF₄ and Si₂H₆, respectively, to the ion source chamber at controlled flow rates in a co-flowed or sequentially flowed manner to produce a silicon-containing dopant composition within the chamber comprising SiF₄ and Si₂H₆ at a predetermined concentration whereby the concentration of Si₂H₆ is greater than about 1 vol% and less than about 10 vol% based on a volume of the overall composition.

19. The method of claim 15, wherein said predetermined operating arc voltage ranges from about 80 V – 120 V.

20. The method of claim 15, wherein a single supply vessel dispenses a concentration comprising about 10 vol% or lower of Si₂H₆ and the balance SiF₄.