Claims

1. A method of using an enriched dopant gas, comprising:

introducing the enriched dopant gas at a flow rate sufficient to maintain stability of the ion source, wherein the enriched dopant gas has an enrichment level in an isotope therein of 90% or greater than natural abundance levels;

operating at a reduced total power level of the ion source in comparison to a total power level utilized for a correspondingly lesser enriched or non-enriched dopant gas; and

ionizing the enriched dopant gas to generate and maintain a beam current as produced using the correspondingly lesser enriched or non-enriched dopant gas at the flow rate.

2. The method of claim 1, further comprising:

operating the ion source at a reduced temperature in comparison to the correspondingly lesser enriched or non-enriched dopant gas at the flow rate; and

operating at the reduced total power level by reducing arc voltage, arc bias, filament power or a combination thereof.

3. The method of claim 1, further comprising maintaining the stability of the ion source by introducing the enriched dopant gas at a flow rate equal to or greater than 1 sccm.

4. The method of claim 3, wherein the enriched dopant gas comprises 72GeF4 at an enrichment level in 72Ge of at least 55%.

5. The method of claim 1, further comprising the step of avoiding recombination reactions by maintaining the flow rate at or below 5 sccm.

6. The method of claim 1, wherein the step of operating at the reduced total power level comprises lowering an ionization efficiency of the enriched dopant

gas in a controlled amount to maintain substantially the same ion beam current as previously qualified with the lesser enriched or the non-enriched dopant gas.

7. The method of claim 1, further comprising the steps of:

operating the ion source with enriched 72GeF4 comprising at least 75% enrichment in 72Ge;

operating at a reduced temperature in comparison to the corresponding lesser enriched or non-enriched 72GeF4 dopant gas at the flow rate, wherein the temperature of the ion source chamber walls range between 400C to 900C; and

reducing the bias between a filament and the cathode of the ion source.

8. The method of claim 1, wherein the step of operating at the reduced total power level occurs by operating at a lower arc voltage in the ion chamber by a predetermined amount.

9. A method of using an enriched dopant gas, comprising:

introducing the enriched dopant gas at a flow rate in a range of 1 to 5 sccm, wherein the enriched dopant gas consists essentially of 72GeF4 having an enrichment level in an isotope of 72Ge greater than 55%;

operating at a reduced total power level in comparison to a total power level utilized for a correspondingly lesser enriched or non-enriched dopant gas;

operating at a reduced temperature of the ion source in comparison to the corresponding lesser enriched or non-enriched dopant gas at the flow rate; and

ionizing the dopant gas to maintain a beam current as produced using a corresponding lesser enriched or non-enriched GeF4 at the flow rate.

10. The method of claim 9, further comprising operating the ion source whereby ion chamber walls have a reduced temperature ranging from 400C to 900C in comparison to the corresponding lesser enriched or non-enriched GeF4 at the flow rate by reducing the bias voltage between a filament and a cathode of the ion source.

11. The method of claim 9, wherein the step of operating at the reduced power level occurs by operating at a lower arc voltage, lower arc bias, lower filament power or a combination thereof.

12. The method of claim 9, wherein the enriched dopant gas consists essentially of 72GeF4 having a highly enriched level in an isotope of 72Ge of 75% or greater.

13. A method for using a highly isotopically enriched dopant gas for an ion implant process, comprising the steps of:

selecting a dopant gas having an atomic species to be implanted into a wafer;

selecting a mass isotope of said atomic species to be enriched at least 90% above natural abundance levels therein;

providing the enriched mass isotope of said dopant gas in a sub-atmospheric storage and delivery container;

introducing the enriched mass isotope of said dopant gas at a flow rate sufficient to maintain stability of the ion source;

operating at a reduced total power level of the ion source in comparison to a total power level utilized for a corresponding lesser enriched or non-enriched dopant gas; and

ionizing the enriched mass isotope of the dopant gas to maintain a beam current as produced using the corresponding lesser enriched or non-enriched dopant gas at the flow rate.

14. The method of claim 13, wherein the flow rate does not exceed an upper limit at which recombination reactions occur.

15. The method of claim 13, wherein the ion source is at a reduced temperature in comparison to the corresponding non-enriched dopant gas at the flow rate.

16. The method of claim 13, wherein the enriched dopant gas is 72GeF4 having an enrichment in 72Ge at 55-60%.

17. The method of claim 13, wherein the enriched dopant gas is 72GeF4 having an enrichment in 72Ge at 55-70% and the reduced total power level is reduced by 5-20% in comparison to the total power level utilized for the corresponding lesser enriched or non-enriched 72GeF4 dopant gas at a flow rate of about 1-3 sccm.

18. The method of claim 13, wherein the enriched dopant gas is 72GeF4 having an enrichment in 72Ge at a range of 70-80%, the reduced total power level being 20-30% lower than the power level utilized for the corresponding lesser enriched or non-enriched 72GeF4 dopant.

19. The method of claim 13, wherein the enriched dopant gas is 72GeF4 having an enrichment in 72Ge at 58% or greater, a reduced filament power level is in a rang e of 200-300 W, the chamber walls have a reduced temperature ranging from 400C to 900C and the flow rate is in range of 1 sccm to 3 sccm.

20. The method of claim 19, further comprising operating at a lower arc voltage in the ion chamber while maintaining the power input to the filament and arc bias unchanged so as to reduce the total power level in comparison to the total power level utilized for the corresponding lesser enriched or non-enriched dopant gas.

CLAIMS

1. A method of using an enriched dopant gas, comprising:

introducing the enriched dopant gas at a flow rate sufficient to maintain stability of the ion source, wherein the enriched dopant gas has an enrichment level in an isotope therein of 90% or greater than natural abundance levels;

operating at a reduced total power level of the ion source in comparison to a total power level utilized for a correspondingly lesser enriched or non-enriched dopant gas; and

ionizing the enriched dopant gas to generate and maintain a beam current as produced using the correspondingly lesser enriched or non-enriched dopant gas at the flow rate.

2. The method of claim 1, further comprising:

operating the ion source at a reduced temperature in comparison to the correspondingly lesser enriched or non-enriched dopant gas at the flow rate; and

operating at the reduced total power level by reducing arc voltage, arc bias, filament power or a combination thereof.

3. The method of claim 1, further comprising maintaining the stability of the ion source by introducing the enriched dopant gas at a flow rate equal to or greater than 1 sccm.

4. The method of claim 3, wherein the enriched dopant gas comprises 72GeF4 at an enrichment level in 72Ge of at least 55%.

5. The method of claim 1, further comprising the step of avoiding recombination reactions by maintaining the flow rate at or below 5 sccm.

6. The method of claim 1, wherein the step of operating at the reduced total power level comprises lowering an ionization efficiency of the enriched dopant gas in a controlled amount to maintain substantially the same ion beam current as previously qualified with the lesser enriched or the non-enriched dopant gas.

7. The method of claim 1, further comprising the steps of:

operating the ion source with enriched 72GeF4 comprising at least 75% enrichment in 72Ge;

operating at a reduced temperature in comparison to the corresponding lesser enriched or non-enriched 72GeF4 dopant gas at the flow rate, wherein the temperature of the ion source chamber walls range between 400C to 900C; and

reducing the bias between a filament and the cathode of the ion source.

8. The method of claim 1, wherein the step of operating at the reduced total power level occurs by operating at a lower arc voltage in the ion chamber by a predetermined amount.

9. A method of using an enriched dopant gas, comprising:

introducing the enriched dopant gas at a flow rate in a range of 1 to 5 sccm, wherein the enriched dopant gas consists essentially of 72GeF4 having an enrichment level in an isotope of 72Ge greater than 55%;

operating at a reduced total power level in comparison to a total power level utilized for a correspondingly lesser enriched or non-enriched dopant gas;

operating at a reduced temperature of the ion source in comparison to the corresponding lesser enriched or non-enriched dopant gas at the flow rate; and

ionizing the dopant gas to maintain a beam current as produced using a corresponding lesser enriched or non-enriched GeF4 at the flow rate.

10. The method of claim 9, further comprising operating the ion source whereby ion chamber walls have a reduced temperature ranging from 400C to 900C in comparison to the corresponding lesser enriched or non-enriched GeF4 at the flow rate by reducing the bias voltage between a filament and a cathode of the ion source.

11. The method of claim 9, wherein the step of operating at the reduced power level occurs by operating at a lower arc voltage, lower arc bias, lower filament power or a combination thereof.

12. The method of claim 9, wherein the enriched dopant gas consists essentially of 72GeF4 having a highly enriched level in an isotope of 72Ge of 75% or greater.

13. A method for using a highly isotopically enriched dopant gas for an ion implant process, comprising the steps of:

selecting a dopant gas having an atomic species to be implanted into a wafer;

selecting a mass isotope of said atomic species to be enriched at least 90% above natural abundance levels therein;

providing the enriched mass isotope of said dopant gas in a sub-atmospheric storage and delivery container;

introducing the enriched mass isotope of said dopant gas at a flow rate sufficient to maintain stability of the ion source;

operating at a reduced total power level of the ion source in comparison to a total power level utilized for a corresponding lesser enriched or non-enriched dopant gas; and

ionizing the enriched mass isotope of the dopant gas to maintain a beam current as produced using the corresponding lesser enriched or non-enriched dopant gas at the flow rate.

14. The method of claim 13, wherein the flow rate does not exceed an upper limit at which recombination reactions occur.

15. The method of claim 13, wherein the ion source is at a reduced temperature in comparison to the corresponding non-enriched dopant gas at the flow rate.

16. The method of claim 13, wherein the enriched dopant gas is 72GeF4 having an enrichment in 72Ge at 55-60%.

17. The method of claim 13, wherein the enriched dopant gas is 72GeF4 having an enrichment in 72Ge at 55-70% and the reduced total power level is reduced by 5-20% in comparison to the total power level utilized for the corresponding lesser enriched or non-enriched 72GeF4 dopant gas at a flow rate of about 1-3 sccm.

18. The method of claim 13, wherein the enriched dopant gas is 72GeF4 having an enrichment in 72Ge at a range of 70-80%, the reduced total power level being 20-30% lower than the power level utilized for the corresponding lesser enriched or non-enriched 72GeF4 dopant.

19. The method of claim 13, wherein the enriched dopant gas is 72GeF4 having an enrichment in 72Ge at 58% or greater, a reduced filament power level is in a rang e of 200-500 W, the chamber walls have a reduced temperature ranging from 400C to 900C and the flow rate is in range of 1 sccm to 3 sccm.

20. The method of claim 19, further comprising operating at a lower arc voltage in the ion chamber while maintaining the power input to the filament and arc bias unchanged so as to reduce the total power level in comparison to the total power level utilized for the corresponding lesser enriched or non-enriched dopant gas.