CLAIMS

What is claimed is:

1. An ion implantation system, comprising:

a gas supply assembly comprising at least one gas supply vessel in fluid communication with an arc chamber,

wherein the arc chamber comprises a target material comprising Ge, and

wherein the gas supply assembly is configured to supply a gas component comprising at least one of GeF_4, GeH_4, H_2, a fluorine-containing gas, or any combination thereof;

wherein, when the gas component is supplied from the at least one gas supply vessel to the arc chamber for implantation into a substrate, a beam current of Ge ions generated from the gas component is greater than a beam current of Ge ions generated from a control gas component.

2. The ion implantation system of claim 1, wherein the at least one gas supply vessel comprises a first vessel comprising GeF_4, and a second vessel comprising GeH_4.

3. The ion implantation system of claim 1, wherein the at least one gas supply vessel comprises a single vessel comprising GeF_4 and GeH_4.

4. The ion implantation system of claim 1, wherein the gas supply assembly further comprises an electrochemical cell configured to generate H_2.

5. The ion implantation system of claim 1, wherein the gas component comprises GeF_4, GeH_4, and H_2.

6. The ion implantation system of claim 1, wherein the gas component comprises GeH_4 and the fluorine-containing gas.

7. The ion implantation system of claim 1, wherein the gas component comprises GeF_4.

8. The ion implantation system of claim 1, wherein the gas component comprises GeH_4.

9. The ion implantation system of claim 1, wherein the gas component comprises GeF_4, GeH_4.

10. The ion implantation system of claim 1, wherein the gas component comprises:

20% to 95% by volume of GeF_4 based on a total volume of the gas component;

5% to 80% by volume of GeH_4 based on the total volume of the gas component;

up to 70% by volume of H_2 based on the total volume of the gas component; and

up to 90% by volume of the fluorine-containing gas based on the total volume of the gas component.

11. The ion implantation system of claim 1, wherein at least one of GeF_4, GeH_4, or GeF_4 and GeH_4 comprises an isotopically enriched germanium.

12. A method of ion implantation, comprising:

flowing a gas component into an arc chamber, the arc chamber comprising a target material comprising Ge,

wherein the gas component comprises at least one of GeF_4, GeH_4, H_2, a fluorine-containing gas, or any combination thereof; and

generating Ge ions from the gas component for implantation into a substrate;

wherein a beam current of the Ge ions generated from the gas component is greater than a beam current of Ge ions generated from a control gas component.

13. The method of claim 12, wherein the flowing comprises flowing the gas component at a flowrate of 0.1 to 5 sccm.

14. The method of claim 12, wherein the target material comprising Ge comprises at least one of pure Ge, a germanium isotope, silicon germanium, or any combination thereof.

15. The method of claim 12, wherein the Ge ions are generated without applying a bias voltage.