

Claims

1. A sub-atmospheric storage and delivery vessel configured for delivering a high purity, vapor phase of antimony-containing material, comprising:
 - a storage and delivery vessel, said storage and delivery vessel configured for holding said antimony-containing material in a liquid phase under sub-atmospheric conditions, whereby said liquid phase is in substantial equilibrium with the high purity, vapor phase of the antimony-containing material, and said high purity, vapor phase of the antimony-containing material exerting a vapor pressure less than atmospheric pressure, said high purity, vapor phase equal to about 95 vol% or greater based on a total volume of the vapor phase;
 - said storage and delivery vessel comprising multiple walls having sufficient surface area contact with the liquid phase, and further wherein said multiple walls exhibit a thermally conductivity to enhance heat conduction into the liquid;
 - said storage and delivery vessel characterized by an absence of external heating and an absence of a carrier gas during dispensing of the high purity, vapor phase antimony-containing material.
2. The sub-atmospheric storage and delivery vessel of claim 1, wherein the antimony-containing material is represented by a non-carbon containing chemical formula to reduce or eliminate formation of carbon-based deposits in an arc chamber of the ion implanter and throughout other regions of the ion source.
3. The sub-atmospheric storage and delivery vessel of claim 1, the thermal conductivity of the multiple walls ranges from 1 to 425 W/m-K, and the antimony-containing material is represented by a non-carbon containing chemical formula to reduce or eliminate formation of carbon-based deposits in the arc chamber and throughout other regions of the ion source.
4. The sub-atmospheric storage and delivery vessel of claim 1, wherein said liquid phase comprise a total amount of liquid phase impurities ranging from 0 to 1 vol% impurities, and further wherein said liquid phase impurities comprises 0 to 0.1 vol% N₂, 0 to 0.1 vol% O₂, 0 to 0.6 vol% HF, 0 to 0.1 vol% SbF₃, 0 to 0.1 vol% Sb₂O₃ and the balance being the antimony-containing material in the liquid phase.

5. A sub-atmospheric storage and delivery vessel configured for delivering a high purity, vapor phase of antimony-containing material, comprising:
- a storage and delivery vessel, said storage and delivery vessel configured for holding said antimony-containing material in a liquid phase under sub-atmospheric conditions, whereby said liquid phase is in substantial equilibrium with the high purity, vapor phase of the antimony-containing material occupying a predetermined volume of headspace in the storage and delivery vessel, and said high purity, vapor phase of the antimony-containing material exerting a vapor pressure less than atmospheric pressure, said high purity, vapor phase equal to about 95 vol% or greater based on the predetermined volume of the headspace;
- said predetermined volume of the headspace being sized so as to receive a sufficient amount of the high purity, vapor phase of the antimony-containing material;
- said storage and delivery vessel characterized by an absence of external heating and an absence of a carrier gas during dispensing of the high purity, vapor phase antimony-containing material.
6. The sub-atmospheric storage and delivery vessel of claim 5, wherein a surface area of the liquid phase that is exposed to the high purity, vapor phase is at least about 50 cm² and further wherein the predetermined volume of the headspace is 1 Liter or greater.
7. The sub-atmospheric storage and delivery vessel of claim 5, further comprising an adsorbent.
8. The sub-atmospheric storage and delivery vessel of claim 5, wherein a pressure in the headspace is greater than or equal to 1 Torr.
9. A high purity antimony containing material in a storage vessel comprising a liquid phase and a vapor phase, said vapor phase comprising a total amount of vapor phase impurities ranging from 0 to 5 vol% impurities wherein the vapor phase impurities comprises 0 to 4 vol% N₂, 0 to 0.5 vol% O₂, 0 to 0.49 vol% HF; 0 to 0.01 vol% H₂O; and the balance being the antimony-containing material in the vapor phase.

10. A high purity antimony-containing material in a storage vessel comprising a liquid phase and a vapor phase, said liquid phase comprising a total amount of liquid phase impurities ranging from 0 to 1 vol% impurities, wherein the liquid phase impurities comprises 0 to 0.1 vol% N₂, 0 to 0.1 vol% O₂, 0 to 0.6 vol% HF, 0 to 0.1 vol% SbF₃, 0 to 0.1 vol% Sb₂O₃ and the balance being the antimony-containing material in the liquid phase.

11. A method of preparing a sub-atmospheric storage and delivery vessel configured for delivery of a steady, sustained and sufficient flow of a high purity, vapor phase of antimony source material, comprising the steps of:

- providing a container with multiple walls having a thermal conductivity of 5 W/m*K;
- performing a fluorine passivation to the multiple walls, followed by;
- introducing an antimony-containing material in a liquid phase into the container in a presence of an inert gas;

- creating a predetermined headspace volume of greater than or equal to about 1 L, said predetermined headspace volume having trace amounts of impurities;

- evaporating a sufficient amount of the antimony containing material into the vapor phase in the predetermined headspace volume, wherein said step of evaporating is performed with an absence of external heating;

- freezing the liquid phase of the antimony containing material to form frozen antimony containing material;

- condensing the vapor phase of the antimony containing material from the predetermined headspace volume to form a condensed high purity, vapor phase;

- evacuating nitrogen, water vapor, the inert gas and any other gaseous impurities from the predetermined headspace volume;

- allowing the condensed vapor phase to increase in temperature so as to form the high purity, vapor phase within the predetermined headspace volume; and

- allowing the frozen antimony containing material to increase in temperature to re-form the liquid phase.

12. The method of claim 11, further comprising performing each of the steps of (i) condensing, (ii) evacuating, and (iii) allowing the condensed high purity, vapor phase and the

frozen antimony containing material to warm so as to re-form the liquid phase and to reform the high purity, vapor phase within the predetermined headspace volume, wherein each of the steps (i), (ii) and (iii) is performed two or more times to achieve vapor phase impurities in the headspace comprising 0 to 4 vol% N₂, 0 to 0.5 vol% O₂, 0 to 0.49 vol% HF and 0 to 0.01 vol% H₂O wherein a total amount of the vapor phase impurities is 5 vol% or lower.

13. A method of using a sub-atmospheric storage and delivery vessel filled with high purity antimony-containing material, comprising:

operably connecting the vessel to a downstream ion implant tool;

establishing a pressure downstream of the sub-atmospheric storage and delivery vessel that is less than the vapor pressure of a high purity, vapor phase of the antimony-containing material occupying a predetermined headspace volume of the vessel;

actuating a valve into the open position;

dispensing the antimony-containing material from the predetermined headspace volume of the vessel in an absence of heating, said antimony-containing material dispensed as a high purity, vapor phase at a flowrate of 0.1 sccm or greater in an absence of a carrier gas; and

flowing the high purity, vapor phase of the antimony-containing material in an absence of the carrier gas at the flowrate of 0.1 sccm or greater towards the ion implant tool; and

evaporating additional antimony-containing material from a corresponding liquid phase in the vessel in the absence of heating to continue supplying the high purity, vapor phase of the antimony-containing material from the headspace at the flowrate of 0.1 sccm or greater.