THE CLAIMS

What is claimed is:

1. A method of controlling the condition of an indirectly heated cathode source in an ion implantation system comprising: a) determining power usage for the indirectly heated cathode source by measuring cathode bias power at a predetermined time; b) comparing the power usage at the predetermined time to initial power; and c) taking corrective actions (i) or (ii) to control the condition of the indirectly heated cathode in response to the comparing whereby

(i) etching the indirectly heated cathode if the power usage at the predetermined time is higher than the initial power; or

(ii) regrowing the indirectly heated cathode if the power usage at the predetermined time is lower than the initial power.

2. The method of Claim 1 wherein the etching of (c)(i) includes operating the indirectly heated cathode under conditions of low to moderate temperature sufficient for etching.

3. The method of Claim 1 wherein the regrowing of (c)(ii) includes flowing a fluorinated gas in a plasma condition over the indirectly heated cathode.

4. The method of Claim 1 wherein the fluorinated gas comprises one or more of XeF_2, XeF_4, XeF_6, GeF_4, SiF_4, BF_3, AsF_5, AsF_3, PF_5, PF_3, F_2, TaF_3, TaF_5, WF_6, WF_5, WF_4, NF_3, IF_5, IF_7, KrF_2, SF_6, C_2F_6, CF_4, ClF_3, N_2F_4, N_2F_2, N_3F, NFH_2, NH_2F, BrF_3, C_3F_8, C_4F_8, C_5F_8, CHF_3, CH_2F_2, CH_3F, COF_2, HF, C_2HF_5, $C_2H_2F_4$, $C_2H_3F_3$, $C_2H_4F_2$, C_2H_5F, C_3F_6, and MoF_6.

5. The method of Claim 1 wherein the regrowing of (c)(ii) includes operating the indirectly heated cathode under conditions of high temperature sufficient for metal deposition to occur.

6. The method of Claim 4 wherein the fluorinated gas comprises one or more OfXeF_2 and N_2F_4.

7. A method of operating an ion implantation system including a cathode in an arc chamber of an ion source, to maintain operating efficiency of the ion source, said method comprising contacting the cathode with a tungsten reagent under conditions selected from the group consisting of:
(a) conditions effecting deposition of tungsten on the cathode; and

(b) conditions effecting etching of deposited material from the cathode,
and said contacting is carried out according to a schedule maintaining power usage of said cathode within predetermined limits.

8. A method of cleaning one or more components of an ion implantation system for at least partial removal of ionization-related deposits form said one or more components, said method comprising flowing a cleaning gas through the system, under conditions selected from the group consisting of:
(a) conditions effecting deposition of material on the cathode; and
(b) conditions effecting etching of deposited material from the cathode,
wherein said cleaning gas comprises XeF_2 and said cleaning gas is flowed through the system at sufficient intervals to maintain leakage current in operation of the system below a predetermined limit.

THE CLAIMS

What is claimed is:

1. A method of controlling the condition of an indirectly heated cathode source in an ion implantation system comprising:

a) determining power usage for the indirectly heated cathode source by measuring cathode bias power at a predetermined time;
b) comparing the power usage at the predetermined time to initial power; and
c) taking corrective actions (i) or (ii) to control the condition of the indirectly heated cathode in response to the comparing whereby
(i) etching the indirectly heated cathode if the power usage at the predetermined time is higher than the initial power; or
(ii) regrowing the indirectly heated cathode if the power usage at the predetermined time is lower than the initial power.

2. The method of Claim 1 wherein the etching of (c)(i) includes operating the indirectly heated cathode under conditions of low to moderate temperature sufficient for etching.

2. The method of Claim 1 wherein the etching of (c)(i) includes operating the indirectly heated cathode under conditions of low to moderate temperature sufficient for etching.

3. The method of Claim 1 or 2 wherein the regrowing of (c)(ii) includes flowing a fluorinated gas in a plasma condition over the indirectly heated cathode.

4. The method of Claim 3 wherein the fluorinated gas comprises one or more of XeF_2, XeF_4, XeF_6, GeF_4, SiF_4, BF_3, AsF_5, AsF_3, PF_5, PF_3, F_2, TaF_3, TaF_5, WF_6, WF_5, WF_4, NF_3, IF_5, IF_7, KrF_2, SF_6, C_2F_6, CF_4, ClF_3, N_2F_4, N_2F_2, N_3F, NFH_2, NH_2F, BrF_3, C_3F_8, C_4F_8, C_5F_8, CHF_3, CH_2F_2, CH_3F, COF_2, HF, C_2HF_5, $C_2H_2F_4$, $C_2H_3F_3$, $C_2H_4F_2$, C_2H_5F, C_3F_6, and MoF_6.

5. The method of Claim 4 wherein the fluorinated gas comprises one or more of XeF_2 and N_2F_4.

6. The method of any one of Claims 1 to 5 wherein the regrowing of (c)(ii) includes operating the indirectly heated cathode under conditions of high temperature sufficient for metal deposition to occur.

7. A method of operating an ion implantation system including a cathode in an arc chamber of an ion source, to maintain operating efficiency of the ion source, said method comprising contacting the cathode with a tungsten reagent under conditions selected from the group consisting of:
(a) conditions effecting deposition of tungsten on the cathode; and
(b) conditions effecting etching of deposited material from the cathode,
and said contacting is carried out according to a schedule maintaining power usage of said cathode within predetermined limits and controlling the temperature of the cathode and the temperature in the arc chamber wall to effect deposition or etching of material at the cathode to maintain a predetermined electrical resistance.

8. Ion implantation system, comprising:
an indirectly heated cathode source;
a controller that controls said system;
wherein the controller
a) determines power usage for the indirectly heated cathode source by measuring cathode bias power at a predetermined time;
b) compares the power usage at the predetermined time to initial power; and
c) takes corrective actions (i) or (ii) to control the condition of the indirectly heated cathode in response to the comparing whereby
(i) etching the indirectly heated cathode if the power usage at the predetermined time is higher than the initial power; or
(ii) regrowing the indirectly heated cathode if the power usage at the predetermined time is lower than the initial power.

9. Ion implantation system, comprising:
an arc chamber of an ion source;
a cathode in the arc chamber
a controller that controls the system;

wherein the controller contacts the cathode with a tungsten reagent under conditions selected from the group consisting of:

(a) conditions effecting deposition of tungsten on the cathode; and

(b) conditions effecting etching of deposited material from the cathode,

and said contacting is carried out according to a schedule maintaining power usage of said cathode within predetermined limits and controlling the temperature of the cathode and the temperature in the arc chamber wall to effect deposition or etching of material at the cathode to maintain a predetermined electrical resistance.