



[0003] An ion source, that is a hardware facility generating ions, is an important portion of the ion implanter. The theorem of the generation of ion source is delineated as utilizing energized thermo electrons to impact the dopant gas molecules under an appropriate low pressure for related ionization so that the dopant ions required by the ion implanter are generated. The ion source is mainly composed by a thermo electron generating device and ionization chamber. Furthermore, the thermo electron device is composed by a filament and a cathode. The filament, for example, a tungsten filament, is implemented to emit thermo electrons which bombard the cathode and heat the cathode so that the cathode can generate thermo electrons which impact interactively with dopant gas in the ionization chamber. Therefore, the desired ionized particles are generated.

[0004] In a conventional cathode design, the cathode is supported by a supporting pole to fix the relative position between cathode and the filament. However, after a period of operation, the surface of supporting pole, contacted with cathode, was eroded due to thermal and reactive gases impact. It would induce the fracture of supporting pole. Moreover, the generation of ion source is terminated due to the fracture of supporting pole. Therefore, it is always a burden for the high frequency - replacement of the cathode in the ion implanter. This invention also provides better beam current stability due to the good thermal stability of cathode.

## SUMMARY OF THE INVENTION

[0005] The invention provides a new design of cathode module which possesses a preferable supporting structure for reducing the maintenance cost of an ion implanter and enhancing the process stability.

[0006] The invention provides a cathode module suitable for an ion source of an ion implanter. The ion source includes an ionization chamber and a supporting body. The chamber is fixed on the supporting body and has an extraction aperture and a through hole. The cathode module includes a cathode, a filament and a clamber. The cathode has a containing cavity, wherein one end of the cathode is inserted into the chamber via the through hole, and another end of the cathode is at outside of the chamber. The filament is installed in the containing cavity to heat the cathode, the thermo electron is emitted from the cathode to ionize a dopant gas in the chamber, and the ionized particles are extracted from the chamber via the extraction aperture. The clamber has a supporting part and two clamping parts, wherein the supporting part is fixed on the supporting body and is connected with the two clamping parts. The supporting part and the two clamping parts constitute a Y-like shape with a containing opening. Another end of the cathode is disposed in the containing opening and held by the two clamping parts.

[0007] In an embodiment of the invention, one of the two clamping parts has a position limiting portion with fixed thickness, which protrudes towards an extending direction of the containing cavity. An end surface of the cathode props against the position limiting portion so that a space exists between the filament and the cathode, wherein the space can be between 0.5 mm and 1.0 mm.

[0008] In an embodiment of the invention, the cathode further has an annular portion surrounding a circumference of the cathode. A diameter of the annular portion can be larger or smaller than a diameter of a through hole, and the surface of the annular portion can be rough, smooth, with groove, with bulge or combined. Besides, the cathode further has at least one annular cutting slot, and the annular cutting slot located

between a main body of the cathode and the annular portion.

[0009] In an embodiment of the invention, the cathode module further comprises a filament mounting element. The filament has two clamping end portions, and the filament mounting element has two clamp arms. An end of each of the clamp arms is  
5 fixed on a supporting body, and each of the clamping end portions of the filament is held by another end of each of the clamp arms.

[0010] In an embodiment of the invention, the supporting part and the two clamping parts are integrally formed.

[0011] In an embodiment of the invention, the ion source further includes a shield  
10 which is disposed on the chamber. The shield has an opening through which an extraction aperture is exposed. In addition, a material of the shield may be tungsten, graphite or related alloys. Moreover, the shield has a plurality of recess portions. Each recess portion is disposed corresponding to each clamping part for containing a portion of each of the clamping parts.

15 [0012] In summary, the cathode module of the invention is held by the two clamping parts of the clasper. With the new cathode design, the stop risk of the ion implanter as a result of the falling-off of the cathode can be avoided during the filament heats the cathode, thereby decreasing the replacing frequency of the ion source and lowering the maintenance cost of the ion implanter.

20 [0013] In order to make the aforementioned and other features and advantages of the invention more comprehensible, several exemplary embodiments accompanied with figures are described in detail below.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. 1 is an assembly view of a cathode module in an embodiment of the invention.

[0015] FIG. 2 is an exploded view of the cathode module in FIG. 1.

5 [0016] FIG. 3 is a partial perspective view of the cathode module in FIG. 1.

[0017] FIG. 4 is a sectional view of the cathode module in FIG. 1 along an A-A cutting line.

## DETAILED DESCRIPTION OF DISCLOSED EMBODIMENTS

10 [0018] FIG. 1 is an assembly view of a cathode module in an embodiment of the invention. FIG. 2 is an exploded view of the cathode module in FIG. 1. FIG. 3 is a partial perspective view of the cathode module in FIG. 1. Please refer to FIGs. 1-3. In the embodiment, a cathode module 100 is suitable for an ion source 1 of an ion implanter (not shown). The ion source 1 includes a chamber 10 and a supporting body  
15 20. The chamber 10 is fixed on the supporting body 20, and the chamber 10 may be constituted of a plurality of baffles 12. The chamber 10 has an extraction aperture 12a and a through hole 12b, wherein the extraction aperture 12a is located on one of the baffles 12 and the through hole 12b is located on another one of the baffles 12. It should be specified that a viewing angle of FIG. 3 is different from a viewing angle of  
20 FIG. 1 so that the views are clear and comprehensible.

[0019] The cathode module 100 includes a cathode 110, a filament 120, a filament mounting element 130, and a clumper 140. The cathode 110 has a containing cavity 112, and the cathode 110 has a first end 110a and a second end 110b, wherein the first end 110a of the cathode 110 is inserted into the chamber 10 via the through hole 12b of

the chamber 10 and the second end 110b of the cathode 110 is at outside of the chamber 10. The filament 120 is installed in the containing cavity 112 to heat the cathode 110, such that the cathode 110 emits a plurality of thermo electrons and interacts with a gas source 14 poured in the chamber 10 to generate a plurality of ionized particles. The ionized particles are extracted from the chamber 10 via the extraction aperture 12a. The filament 120 is mounted by the filament mounting element 130. The clamper 140 has a supporting part 142 and two clamping parts 144, wherein the supporting part 142 is fixed on the supporting body 20 and is connected with the two clamping parts 144. Moreover, the supporting part 142 and the two clamping parts 144 constitute a Y-like shape with a containing opening 140a. The second end 110b of the cathode 110 is disposed in the containing opening 140a of the clamper 140 and is held by the two clamping parts 144. Therefore, after the filament 120 is connected with power and emits a plurality of thermo electrons for heating the cathode 110, since the two clamping parts 144 of the clamper 140 hold at an outside surface of the second end 110b of the cathode 110, thereby avoiding a falling-off risk of the cathode 110 as a result of heating the filament 120 and a worn-out generated by a gas reaction between the cathode 110 and the gas source 14, thereby reducing a replacing frequency of the ion source 1 and lowering a maintenance cost of the ion implanter.

[0020] FIG. 4 is a sectional view of the cathode module in FIG. 1 along an A-A cutting line. Please refer to FIGs. 1, 3, and 4. One of the two clamping parts 144 in the embodiment may have a position limiting portion 144a with a fixed thickness, which protrudes towards an extending direction D of the containing cavity 112 of the cathode 110, wherein the extending direction D faces towards the first end 110a of the cathode 110 from the second end 110b of the cathode 110. An end surface 110c of the

second end 110b of the cathode 110 props against the position limiting portion 144a, such that a space S exists between the filament 120 and the cathode 110. Further, when the filament 120 heats the cathode 110, a distance can be kept between the filament 120 and the cathode 110 to satisfy a distance for thermo electrons emitted by the filament 120 to bombard the cathode 110. Therefore, when the end surface 110c of the cathode 110 props against the position limiting portion 144a of the clamper 140, the space S between the filament 120 and the cathode 110 may serve a function of aligning a position of the filament 120, wherein the space S is between 0.5mm and 1.0mm, and the space S in the embodiment is 0.7 mm preferably. Moreover, when the space S is 0.7 mm, an optimal distance can be kept between the filament 120 and the cathode 110.

[0021] In addition, in order to further limit a relative position of the cathode 110 and the filament 120 to avoid a discrepancy in the space S between the filament 120 and the cathode 110, the supporting part 142 and the two clamping parts 144 in the embodiment may be an integrally formed structure so that the clamper 140 can have a preferable size accuracy to avoid a discrepancy in the space S as a result of an assembly tolerance of the clamper 140. It should be specified that the supporting part and the two clamping parts of the invention not only can be manufactured integrally, in another embodiment, the supporting part and the two clamping parts also can be manufactured individually and then be assembled together. Therefore, a user can select a manufacturing method of the supporting part and the two clamping parts depending on an actual situation.

[0022] Please refer to FIGs. 2-3, the filament 120 in the embodiment has two clamping end portions 122, and the filament mounting element 130 has two clamp arms 132. A first end 132a of each of the clamp arms 132 is fixed on the supporting body

20, and a second end 132b of each of the clamp arms 132 holds each of the clamping end portions 122 so that the filament 120 is easily to be assembled.

[0023] Please refer to FIGs. 2, 3, and 4. The cathode 110 in the embodiment further has an annular portion 114 surrounding a circumference of the cathode 110. A diameter d1 of the annular portion 114 of the cathode 110 is larger or smaller than a diameter d2 of the through hole 12b of the chamber 10, thereby avoiding the leakage of the gas source 14 in the chamber 10 and the dissipation of heat from the chamber 10 so as to increase stability of ions in the chamber 10. In addition, when the cathode 110 is embedded in the through hole 12b of the chamber 10, the diameter d1 of the annular portion 114 can be larger or smaller than the diameter d2 of the through hole 12b of the chamber 10, the annular portion 114 can also serve a function of positioning the cathode 110. In addition, the surface of the annular portion 114 can be rough, smooth, with groove, with bulge or combined to add the friction for holding the clamper, such that the fall probability of the clamper can be reduced.

[0024] Following the aforementioned, the cathode 110 further has at least one annular cutting slot 116, and the annular cutting slot 116 is located between a main body (not marked) of the cathode 110 and the annular portion 114. In addition, the annular cutting slot 116 is passed through the containing cavity 112 by the circumference of the cathode 110 and is disposed adjacently to the annular portion 114.

Further, after the filament 120 emits a plurality of thermo electrons and keeps heating the cathode 110 for a period of time, a surface of the cathode 110 generates heat which is conducted to the clamper 140, generating a melting risk of the clamper 140. Therefore, with the disposition of the annular cutting slot 116, the heat transported from the cathode 110 to the two clamping parts 144 can be reduced due to the annular cutting

slot 116 so as to reduce the melting risk of the two clamping parts 144 as a result of  
overheat.

[0025] Please refer to FIGs. 1-3. In the embodiment, the cathode module 100  
further includes a shield 150 which is disposed on the chamber 10. The shield 150 has  
5 an opening 152 through which the extraction aperture 12a of the chamber 10 exposes.  
With the disposition, the shield 150 blocks the heat from the chamber 10 and also  
reduces the dissipation of thermal energy of the chamber 10. In addition, a material of  
the shield 150 in the embodiment may be heat-endurable, for example, tungsten, or  
related alloys, thereby the heat from the chamber 10 can be blocked and the tungsten, or  
10 related alloys also has an advantage of high strength. In addition, in another  
embodiment, the material of the shield 150 may be graphite, thereby the heat from the  
chamber 10 can be blocked and the graphite is relatively cheaper in comparison with the  
tungsten. In other words, when the shield 150 needs to satisfy an intensity requirement,  
the tungsten or related alloys may be adopted as the material of the shield 150.  
15 Reversely, when the shield 150 needs to satisfy a price requirement, the graphite may be  
adopted as the material of the shield 150.

[0026] Moreover, the shield 150 has a plurality of recess portions 154. Each of the  
recess portions 154 is disposed corresponding to each of the clamping parts 144 for  
containing a portion of each of the clamping parts 144, thereby avoiding a contacting  
20 risk of the shield 150 with the clasper 140 which leads to stop running of the ion  
implanter.

[0027] In summary, the clasper of the invention has the supporting part and the two  
clamping parts. The supporting part and the two clamping parts constitute the Y-like  
shape with the containing opening. After the cathode is mounted in the containing

opening, the two clamping parts hold an outside surface of the cathode, thereby effectively avoiding a falling-off risk of the cathode due to heating by the filament, so as to reduce the replacing frequency of the ion source and lower the maintenance cost of the ion implanter. In addition, when the two clamping parts has at least one position  
5 limiting portion, the space can exist between the filament and the cathode for aligning a position of the filament. Moreover, the cathode may further have the annular portion and the diameter thereof is larger or smaller than the diameter of the through hole of the chamber so as to prevent the gas source or thermal energy in the chamber from dissipating or to serve a function of positioning the cathode. In addition, the cathode  
10 module may further include the shield to reduce the dissipation of the thermal energy in the chamber, wherein a material of the shield can be tungsten , graphite or related alloys.

[0028] Although the invention has been disclosed by the above embodiments, the embodiments are not intended to limit the invention. It will be apparent to those  
15 skilled in the art that various modifications and variations can be made to the structure of the invention without departing from the scope or spirit of the invention. Therefore, the protecting range of the invention falls in the appended claims.

WHAT IS CLAIMED IS:

1. A cathode module suitable for an ion source of an ion implanter, the ion source comprising: a chamber and a supporting body, the chamber fixed on the supporting body and having an extraction aperture and a through hole, the cathode  
5 module comprising:

a cathode, having a containing cavity, one end of the cathode inserted into the chamber via the through hole, and another end of the cathode being at outside of the chamber;

a filament, installed in the containing cavity to heat the cathode, the thermo  
10 electron emitted from the cathode ionizing a dopant gas in the chamber, the ionized particle being extracted from the chamber via the extraction aperture;

a clamper, having a supporting part and two clamping parts, wherein the supporting part is fixed on the supporting body, the supporting part and the two clamping parts constituting a Y-like shape with a containing opening, another end of  
15 the cathode disposed in the containing opening and held by the two clamping parts.

2. The cathode module according to claim 1, wherein the clamping parts have position limiting portions, and the position limiting portion protruding towards an extending direction of the containing cavity, the another end of the cathode propping against the position limiting portion so that a space exists between the filament and the  
20 cathode.

3. The cathode module according to claim 2, wherein the space is between 0.5mm and 1.0mm.

4. The cathode module according to claim 1, wherein the cathode further has an annular portion connected to the cathode, and a diameter of the annular portion is

larger or smaller than a diameter of the through hole, and the surface of the annular portion can be rough, smooth, with groove, with bulge or combined.

5        5. The cathode module of claim 4, wherein the cathode further has at least one annular cutting slot, and the annular cutting slot located between a main body of cathode and the annular portion.

10       6. The cathode module according to claim 1, further comprising a filament mounting element, wherein the filament has two clamping end portions, and the filament mounting element has two clamp arms, an end of each of the clamp arms fixing on the supporting body, and each of the clamping end portions of filament held by another end of each of the clamp arms.

7. The cathode module according to claim 1, wherein the supporting part and the two clamping parts are integrally formed.

15       8. The cathode module according to claim 1, further comprising a shield disposed on the chamber, the shield having an opening through which the extraction aperture exposing.

9. The cathode module according to claim 8, wherein a material of the shield can be tungsten, graphite or related alloys.

20       10. The cathode module according to claim 8, wherein the shield has a plurality of recess portions and each of the recess portions disposed corresponding to each of the clamping parts.