

Embodiments of the present invention seek to provide~~has the task of providing~~ a method with which such a fast burning through can be avoided and thus the duration of operation, i.e. the filament's service life, can be increased.

According to a first aspect of the present invention, there is provided a plasma source on a vacuum chamber for generating a plasma in the vacuum chamber, wherein the plasma source comprises a source housing with an opening protruding into the vacuum chamber and wherein, in the source housing, a filament is provided to which a heater voltage V_{heiz} can be applied through electric lines running insulated through the source housing, so that the filament can be heated by means of the current flow, wherein the source housing is placed on the vacuum chamber in a manner electrically insulated therefrom, wherein means are provided for measuring the potential drop U_{float} between the supply line to the filament and the source housing as characteristic for the state of the potential drop between the filament and plasma ignited inside the source housing and means are provided for regulating the heater voltage V_{heiz} that are designed in such a manner that they can process the measured value U_{float} as control signal, and in doing so the potential drop can be maintained constant and thereby the temperature of the filament can be maintained nearly constant.

According to a second aspect of the present invention, there is provided a device with a plurality of plasma sources as defined in the first aspect, wherein the plasma sources are surrounded respectively by at least one source coil and the plasma sources are surrounded by an outer coil comprising several plasma sources extending above the processing height.

According to a third aspect of the present invention, there is provided a device comprising a plasma source as defined in the first aspect or comprising a plurality of plasma sources as defined in the second aspect, wherein the heater voltage is fed by means of at least one switched-mode power supply, wherein preferably a discharge voltage U_{disc} required for the discharge is applied centrally and opposite the filament.

According to a fourth aspect of the present invention, there is provided a method for generating a plasma in a vacuum chamber, wherein a plasma source as defined in the first aspect with source housing and filament is placed on the vacuum chamber, and in order to maintain the plasma, the source housing is maintained opposite the vacuum chamber and the filament on a floating electric potential, i.e. in a floating manner, and wherein, in order to maintain the plasma, the potential drop between the filament and the source housing inside which a plasma is burning is measured and the measured potential drop is used for regulating a heater voltage applied to the filament, wherein the heater voltage results in a current heating the filament and thus in an emission of electrons.

During their experiments to increase the service life, the inventors have noticed on the one hand that at a temperature of the filament wire that is maintained constant, the wire diameter is reduced at a nearly constant rate. Figure 3 shows the evolution of the wire diameter depending on the duration of operation of the filament, at a constant temperature and in comparison with a measurement at constant current strength.

In their experiments, the inventors on the other hand have surprisingly noticed that when operating at a constant drop of potential between the filament and the plasma, the temperature of the filament remains nearly constant and the evaporation rate even decreases when the filament diameter decreases.

According to embodiments of the invention, the filament is thus operated not at constant current strength but at constant voltage.

Embodiments of the invention will now be described in detail on the basis of the figures by way of example. Figure 4 shows a plasma source according to the state of the art, which is placed on a vacuum chamber 1. The plasma source comprises a source housing 3 with an inlet 5 for argon gas. In the source housing 3, a filament 9 is provided that is connected to a transformer 13 via openings 11 insulated from the source housing 3. The filament 9 consists in the example of a tungsten wire with a diameter of 2mm. The transformer is operated in the example with an AC voltage of 50Hz. A heater current of approx. 200A flows through the filament 9. If the surface of the filament 9 reaches a temperature greater than 2900K, a sufficient number of electrons are emitted from the filament surface which, when a discharge voltage is applied by means of a voltage source 15 between the vacuum chamber 15 and the transformer 13, the argon gas flowing through the inlet 5 into the inside of the source housing 3 can ionize. The ignition of the discharge occurs in the first moment over a resistance that connects the source housing 3 with the mass (not shown).