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(54) **DISHWASHER AND CONTROL METHOD THEREFOR**

GESCHIRRRSPÜLER UND STEUERUNGSVERFAHREN DAFÜR

LAVE-VAISSELLE ET SON PROCÉDÉ DE COMMANDE

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Description

Cross-Reference to Related Disclosure

[0001] The present invention claims the priority of Chinese Patent Disclosure No. 201811419584.0, filed on November 26, 2018 and entitled "Dishwasher and Method for Controlling Dishwasher", and the priority of Chinese Patent Disclosure No. 201811420522.1, filed on the same day and entitled "Novel Dishwasher and Method for Controlling Novel Dishwasher".

Technical Field

[0002] The present invention belongs to the technical field of dishwashers, and particularly relates to a dishwasher and a method for controlling the dishwasher.

Background

[0003] With improvement of an oil removal capacity, a dishwasher has been increasingly recognized by consumers, a related market has also been growing, and there has been a trend towards replacing household disinfection cabinets, which requires the dishwasher to have the characteristics of efficiency, fastness and broad-spectrum sterilization. At present, hot water sterilization (70-80°C), high temperature and high pressure sterilization, ultraviolet sterilization, ozone sterilization and other methods are often used by the dishwasher, which are inefficient and cannot effectively kill bacteria. Therefore, it is necessary to introduce efficient, rapid and environmentally-friendly sterilization means into the dishwasher.

[0004] Common sterilization methods mainly include thermal sterilization, ionizing radiation, plasma sterilization, chemical sterilization, etc. A temperature of hot water in the dishwasher is less than 100°C, which does not reach a temperature required by the thermal sterilization. Accordingly, hot water sterilization does not effectively remove bacteria in the dishwasher. The high temperature and high pressure sterilization has poor stability and is difficult to control. Space of the dishwasher is narrow, a distance between bowls is relatively small, and the bowls block each other, such that ultraviolet rays can not effectively act on each bowl. If an ozone concentration in the dishwasher is too high, a hypochlorous acid and so on in tap water may be oxidized and therefore substances harmful to human health are produced.

[0005] In contrast, the plasma sterilization has the following characteristics: (1) has the broad-spectrum antibacterial property, it generally takes several minutes to reach a sterility assurance level; (2) a temperature of a plasma gas is close to a room temperature, so the plasma gas can be used to sterilize heat sensitive materials, and therefore dramatical reduction of a usage amount of disposable medical materials and medical costs are expectable; and (3) biological substances with strong resistance can be efficiently eliminated, which include super bacte-

ria with strong drug resistance, prions with strong temperature resistance, bacterial biofilm with a group protection function, etc., and odorous gases can be effectively removed. This sterilization method is expected to solve the sterilization problem faced by an existing dishwasher, but the difficulty in generating plasma in the dishwasher is how to generate large-area plasma to cover a surface of tableware under an atmospheric pressure.

[0006] Theoretically, generation of the plasma is related to an electric field between electrodes, an electrode spacing and an initial electron number density, and therefore, large-area plasma may be generated by designing a reasonable electrode structure.

[0007] The patent application KR 20040110559 A discloses a tableware sterilizer using a plasma chip and a tableware sterilizing method to improve the sterilization effect by sterilizing the tablewares with the ions generated from a plasma chip and using an airflow generated by a fan. The tableware sterilizer using a plasma chip comprises a plasma chip generating plasma ions by the atmospheric discharge and having a fan generating an airflow for dispersing the plasma ions, an ultraviolet ray lamp radiating ultraviolet rays having sterilization function, a sterilization rack on which tablewares are placed, a nano silver filter sterilizing the air in a sterilizer, a carbon filter generating fresh oxygen by decomposing ozone, a blower fan guiding the airflow to the nano silver filter and the carbon filter, and a heater drying the tablewares and finally decomposing ozone.

[0008] The patent application US 2013/0319460 A1 discloses a cleaning apparatus for cleaning articles. The cleaning apparatus comprises at least one cleaning chamber for receiving the articles. The cleaning apparatus comprises, in the cleaning chamber, at least one fluid source for subjecting the articles to the action of at least one cleaning fluid. The cleaning apparatus furthermore comprises at least one plasma source, which is designed to ignite at least one plasma in at least one gas and to generate at least one reactive gas. The cleaning apparatus is designed to bring the reactive gas into contact with the articles, at least in part.

[0009] The patent application CN 1109365A discloses a cold plasma sterilizing device. The device has a casing with door. Anode-plates are installed on the upper and lower sides of the casing and cathode plate is installed between the anode plates. The distance between the anode plate and the cathode plate is 20-80 cm, the voltage between the anode plate and the cathode plate is 300-1000V, discharging current is 0.5-2A. A pipeline and an aeration valve are installed on the casing connecting to a vacuum pump. The pressure in the casing is 1.33 Pa-400 Pa.

[0010] The patent application JP 10-5165 A discloses a dishwasher having a washing chamber in which electrodes have been installed. Dishes to be washed are mounted between electrodes in the washing chamber. When the washing chamber is closed and sealed, a vacuum pump is started so as to reduce the pressure in the

washing chamber and after reaching a prescribed vacuum degree, a prescribed volume of gas is started to flow in. At the same time, the current whose voltage is increased by a high voltage power supply is fed to the electrodes so as to excite across the electrodes into a plasma state. This constitution permits the gas present between the electrodes to become an excited state, resolves and vaporizes the dirt stuck to the surface of the dishes, and sucks and disposes the vaporized dirt in the vacuum side.

Summary

[0011] The present invention provides a dishwasher and a method for controlling the dishwasher.

[0012] The dishwasher includes a housing and further includes a plasma sterilization and disinfection apparatus arranged inside the housing, the plasma sterilization and disinfection apparatus includes a discharge electrode plate, a ground electrode plate, a radio-frequency power supply and an earthing power supply, a tableware storage space is formed between the discharge electrode plate and the ground electrode plate, the radio-frequency power supply is connected to the discharge electrode plate, and the earthing power supply is connected to the ground electrode plate, wherein the discharge electrode plate is arranged at a top inside the housing, and the ground electrode plate is arranged at a bottom inside the housing,

wherein the discharge electrode plate and the ground electrode plate are arranged parallel to each other and respectively parallel to a horizontal plane of the housing,

wherein a distance between the discharge electrode plate and the ground electrode plate is 150-250 mm.

[0013] In some embodiments, an area of the discharge electrode plate is greater than an area of the ground electrode plate.

[0014] In some embodiments, a separating apparatus is arranged in the tableware storage space and configured to separate tableware.

[0015] In some embodiments, a value of a discharge voltage of the radio-frequency power supply is 1-5 kV.

[0016] In some embodiments, the discharge electrode plate and the ground electrode plate are made of conductive materials.

[0017] The method for controlling a dishwasher is configured to control the above dishwasher and includes the following steps:

placing a tableware in a tableware storage space formed between a discharge electrode plate and a ground electrode plate, wherein the tableware serves as an insulation medium;

performing electrification for sterilization: applying a voltage to the discharge electrode plate connected to a radio-frequency power supply, to form an electric

field between the discharge electrode plate and the ground electrode plate; and
ionizing air on a surface of the insulation medium, to form plasma to cover the surface of the insulation medium.

[0018] In some embodiments, before performing the electrification for sterilization, further comprises: cleaning the tableware by the dishwasher.

[0019] In some embodiments, after cleaning the tableware by the dishwasher, the method further comprises: heating for evaporating water on the surface of the tableware.

Brief Description of the Drawings

[0020]

Fig. 1 is a structural schematic diagram of a dishwasher of some embodiments;

Fig. 2 is a structural schematic diagram of a dishwasher of another embodiment; and

Fig. 3 is a flow chart of a method for controlling the dishwasher.

Detailed Description of the Embodiments

[0021] The technical solutions of the present invention will be described below clearly and comprehensively in conjunction with accompanying drawings of the embodiments of the present invention.

[0022] As shown in Fig. 1, (exemplary embodiment, not falling under the wording of the claims) a dishwasher is provided.

[0023] The dishwasher includes a housing 100, and a plasma sterilization and disinfection apparatus arranged inside the housing 100, the plasma sterilization and disinfection apparatus includes a plurality of discharge electrode plates 101 and 103, a plurality of ground electrode plates 102 and 104, a radio-frequency power supply 105 and an earthing power supply 106. The discharge electrode plates 101 and 103 and the ground electrode plates 102 and 104 are made of conductive materials. The discharge electrode plate and the ground electrode plate are alternatively arranged, that is, one ground electrode plate 102 is arranged between two discharge electrode plates 101 and 103, one discharge electrode plate 103 is arranged between two ground electrode plates 102 and 104, in addition, the discharge electrode plates 101 and 103 and the ground electrode plates 102 and 104 are arranged parallel to each other and respectively perpendicular to a horizontal plane of the housing 100, and a distance between any two adjacent discharge electrode plates is equal to a distance between any two adjacent ground electrode plates. A distance between either of the discharge electrode plates 101 and 103 and an adjacent ground electrode plate of the ground electrode plates 102 and 104 is 50 mm, which is conducive to ster-

ilization and disinfection after placement of tableware. A tableware storage space is formed between the discharge electrode plates 101 and 103 and the ground electrode plates 102 and 104, such that it is guaranteed that the tableware is not overlapped, and generated glow plasma covers a surface of the tableware, to sterilize and disinfect the tableware more effectively.

[0024] The radio-frequency power supply 105 is connected to the discharge electrode plates 101 and 103, and the earthing power supply 106 is connected to the ground electrode plates 102 and 104. A value of a discharge voltage of the radio-frequency power supply 105 is 1-5 kV. By selecting an appropriate voltage and designing reasonable discharge structure, the sterilization effect of the dishwasher is more efficient.

[0025] In these embodiments, metal electrodes which are alternatively arranged are designed, that is, the plurality of discharge electrode plates 101 and 103 and the plurality of ground electrode plates 102 and 104 are used to replace an original rack divider in the dishwasher, such that the tableware is placed between two metal electrodes. During operation, two adjacent electrodes are connected to a radio-frequency high voltage and earthed separately, and tableware to be treated is used as an insulation medium, and large-area glow plasma is successfully generated under an atmospheric pressure. The module is installed inside the dishwasher, such that large-area glow discharge plasma is generated on a surface of the tableware inside the dishwasher, to disinfect and sterilize the tableware. Plasma sterilization is fast in speed, strong in effect and wide in range, and no secondary pollution is generated after treatment. Because of air ionization, there will be no consumable consumption, and long-term operation and low power consumption can be achieved.

[0026] As shown in Fig. 2, according to the invention a dishwasher is provided. The dishwasher includes a housing 100, and a plasma sterilization and disinfection apparatus arranged inside the housing 100, the plasma sterilization and disinfection apparatus includes a discharge electrode plate 101, a ground electrode plate 104, a radio-frequency power supply 105 and an earthing power supply 106. The discharge electrode plate 101 is arranged at a top inside the housing 100, and the ground electrode plate 104 is arranged at a bottom inside the housing 101. The discharge electrode plate 101 and the ground electrode plate 104 are made of conductive materials. The discharge electrode plate 101 and the ground electrode plate 104 are arranged parallel to each other and respectively parallel to a horizontal plane of the housing 100. A distance between the discharge electrode plate 101 and the ground electrode plate 104 is 200 mm, and an area of the discharge electrode plate 101 is greater than an area of the ground electrode plate 104, such that large-area glow plasma can be generated in the dishwasher, to sterilize tableware more effectively.

[0027] A tableware storage space is formed between the discharge electrode plate 101 and the ground elec-

trode plate 104, and a separating apparatus 107 is arranged in the tableware storage space for separate tableware, such that the tableware is sterilized more thoroughly. The radio-frequency power supply 105 is connected to the discharge electrode plate 101, and a value of a discharge voltage of the radio-frequency power supply is 1-5 kV, and the earthing power supply 106 is connected to the ground electrode plate 104. By selecting an appropriate voltage and designing a reasonable discharge structure, a sterilization effect of the dishwasher is more efficient.

[0028] In these above embodiments, by designing two plate-shaped electrodes which are opposite up and down, namely, the discharge electrode plate 101 and the ground electrode plate 104, tableware to be treated is taken as an insulation medium, and large-area glow plasma is successfully generated under an atmospheric pressure. The module is installed inside the dishwasher, such that large-area glow discharge plasma is generated on a surface of the tableware inside the dishwasher, to disinfect and sterilize the tableware. Plasma sterilization is fast in speed, strong in effect and wide in range, and no secondary pollution is generated after treatment. Because of air ionization, there will be no consumable consumption, and long-term operation and low power consumption can be achieved.

[0029] As shown in Fig. 3, according to the invention a method for controlling a dishwasher is provided.

[0030] The method is configured to control the dishwasher of any embodiment described above and includes the following steps:

S1: a tableware is placed in a tableware storage space formed between a discharge electrode plate and a ground electrode plate, and the tableware serves as an insulation medium;

S2: electrification for sterilization is performed: and a voltage to the discharge electrode plate connected to a radio-frequency power supply is applied, to form an electric field between the discharge pole plate and the ground electrode plate; and

S3: air on a surface of the insulation medium is ionized, to form plasma to cover a surface of the tableware for sterilization.

[0031] In some embodiments, the dishwasher firstly cleans the tableware before electrification for sterilization. In some other embodiments, after cleaning is completed, water on the surface of the tableware is heated for evaporating at a high temperature by the dishwasher. In steps S2 and S3, the voltage is applied to the discharge electrode plate through the radio-frequency power supply, to form a large-area high-voltage area between the discharge electrode plate and the ground electrode plate, the tableware located between the discharge electrode plate and the ground electrode plate is used as the insulation medium, and the electric field formed between the discharge electrode plate and the ground electrode plate

ionizes the air on the surface of the tableware to form glow plasma, which covers the surface of the tableware serving as the insulation medium, thereby killing bacteria and viruses on the tableware and achieving the purpose of sterilization and disinfection on the tableware.

Claims

1. A dishwasher, comprising a housing (100), wherein the dishwasher further comprises a plasma sterilization and disinfection apparatus arranged inside the housing (100), wherein the plasma sterilization and disinfection apparatus comprises a discharge electrode plate (101), a ground electrode plate (104), a radio-frequency power supply (105) and an earthing power supply (106), a tableware storage space is formed between the discharge electrode plate (101) and the ground electrode plate (104), the radio-frequency power supply (105) is connected to the discharge electrode plate (101), and the earthing power supply (106) is connected to the ground electrode plate (104), wherein the discharge electrode plate (101) and the ground electrode plate (104) are arranged parallel to each other and respectively parallel to a horizontal plane of the housing (100),

characterized in that the discharge electrode plate (101) is arranged at a top inside the housing (100), and the ground electrode plate (104) is arranged at a bottom inside the housing (100), wherein a distance between the discharge electrode plate (101) and the ground electrode plate (104) is 150-250 mm.

2. The dishwasher according to claim 1, wherein an area of the discharge electrode plate (101) is greater than an area of the ground electrode plate (104).
3. The dishwasher according to claim 1, wherein a separating apparatus (107) is arranged in the tableware storage space and configured to separate tableware.
4. The dishwasher according to claim 1, wherein a value of a discharge voltage of the radio-frequency power supply (105) is 1-5 kV.
5. The dishwasher according to claim 1, wherein the discharge electrode plate (101) and the ground electrode plate (104) are respectively made of conductive materials.
6. A method for controlling a dishwasher, wherein the method controls the dishwasher according to any one of claims 1 to 5, and comprises the following steps:

placing a tableware in a tableware storage

space formed between a discharge electrode plate (101) and a ground electrode plate (104), wherein the tableware serves as an insulation medium;

performing electrification for sterilization: applying a voltage to the discharge electrode plate (101) connected to a radio-frequency power supply (105), to form an electric field between the discharge electrode plate (101) and the ground electrode plate (104); and ionizing air on a surface of the insulation medium, to form plasma to cover the surface of the insulation medium.

7. The method for controlling the dishwasher according to claim 6,

wherein before performing the electrification for sterilization, further comprises: cleaning the tableware by the dishwasher, wherein after cleaning the tableware by the dishwasher, the method further comprises: heating for evaporating water on the surface of the tableware.

Patentansprüche

1. Geschirrspüler, umfassend ein Gehäuse (100), wobei der Geschirrspüler ferner ein Plasmasterilisations- und -desinfektionsgerät umfasst, das innerhalb des Gehäuses (100) angeordnet ist, wobei das Plasmasterilisations- und -desinfektionsgerät eine Entladungselektrodenplatte (101), eine Masseelektrodenplatte (104), eine Funkfrequenzenergieversorgung (105) und eine Erdungsenergieversorgung (106) umfasst, ein Geschirrlagerungsraum zwischen der Entladungselektrodenplatte (101) und der Masseelektrodenplatte (104) gebildet ist, die Funkfrequenzenergieversorgung (105) mit der Entladungselektrodenplatte (101) verbunden ist und die Erdungsenergieversorgung (106) mit der Masseelektrodenplatte (104) verbunden ist, wobei die Entladungselektrodenplatte (101) und die Masseelektrodenplatte (104) parallel zueinander und jeweils parallel zu einer horizontalen Ebene des Gehäuses (100) angeordnet sind,

dadurch gekennzeichnet, dass die Entladungselektrodenplatte (101) oben innerhalb des Gehäuses (100) angeordnet ist und die Masseelektrodenplatte (104) unten innerhalb des Gehäuses (100) angeordnet ist, wobei ein Abstand zwischen der Entladungselektrodenplatte (101) und der Masseelektrodenplatte (104) 150-250 mm beträgt.

2. Geschirrspüler nach Anspruch 1, wobei ein Bereich

der Entladungselektrodenplatte (101) größer ist als ein Bereich der Masseelektrodenplatte (104).

3. Geschirrspüler nach Anspruch 1, wobei ein Trenn-
gerät (107) in dem Geschirrlagerungsraum angeord-
net und konfiguriert ist, Geschirr zu trennen. 5
4. Geschirrspüler nach Anspruch 1, wobei ein Wert ei-
ner Entladungsspannung der Funkfrequenzenergie-
versorgung (105) 1-5 kV beträgt. 10
5. Geschirrspüler nach Anspruch 1, wobei die Entla-
dungselektrodenplatte (101) und die Masseelektro-
denplatte (104) jeweils aus leitfähigen Materialien
hergestellt sind. 15
6. Verfahren zum Steuern eines Geschirrspülers, wo-
bei das Verfahren den Geschirrspüler nach einem
der Ansprüche 1 bis 5 steuert und die folgenden
Schritte umfasst: 20

Legen eines Geschirrs in einen Geschirrlage-
rungsraum, der zwischen einer Entladungselek-
trodenplatte (101) und einer Masseelektroden-
platte (104) gebildet ist, wobei das Geschirr als
Isolationsmedium dient;
Durchführen der Elektrifizierung zur Sterilisati-
on: 25

Anwenden einer Spannung auf die Entla-
dungselektrodenplatte (101), die mit einer
Funkfrequenzenergieversorgung (105)
verbunden ist, um ein elektrisches Feld zwi-
schen der Entladungselektrodenplatte
(101) und der Masseelektrodenplatte (104)
zu bilden; und
Ionisieren der Luft auf einer Oberfläche des
Isolationsmediums, um ein Plasma zu bil-
den, um die Oberfläche des Isolationsme-
diums abzudecken. 30

7. Verfahren zum Steuern des Geschirrspülers nach
Anspruch 6,
wobei es vor dem Durchführen der Elektrifizie-
rung zum Sterilisieren ferner Folgendes um-
fasst: Reinigen des Geschirrs durch den Ge-
schirrspüler,
wobei nach dem Reinigen des Geschirrs durch
den Geschirrspüler das Verfahren ferner Fol-
gendes umfasst:
Erwärmen zum Verdampfen von Wasser auf der
Oberfläche des Geschirrs. 35
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Revendications

1. Lave-vaisselle comprenant un boîtier (100), dans le- 55

quel le lave-vaisselle comprend en outre un appareil
de stérilisation et de désinfection au plasma disposé
à l'intérieur du boîtier (100), dans lequel l'appareil
de stérilisation et de désinfection au plasma com-
prend une plaque d'électrode de décharge (101),
une plaque d'électrode de terre (104), une alimen-
tation électrique radiofréquence (105) et une alimen-
tation électrique de mise à la terre (106), un espace
de stockage de vaisselle est formé entre la plaque
d'électrode de décharge (101) et la plaque d'élec-
trode de terre (104), l'alimentation électrique ra-
diofréquence (105) est connectée à la plaque d'élec-
trode de décharge (101), et l'alimentation électrique
de mise à la terre (106) est connectée à la plaque
d'électrode de terre (104), dans lequel la plaque
d'électrode de décharge (101) et la plaque d'élec-
trode de terre (104) sont disposées de manière pa-
rallèle l'une à l'autre et respectivement de manière
parallèle à un plan horizontal du boîtier (100),

caractérisé en ce que la plaque d'électrode de
décharge (101) est disposée en haut à l'intérieur
du boîtier (100), et la plaque d'électrode de terre
(104) est disposée en bas à l'intérieur du boîtier
(100),
dans lequel une distance entre la plaque d'élec-
trode de décharge (101) et la plaque d'électrode
de terre (104) est de 150 à 250 mm.

2. Lave-vaisselle selon la revendication 1, dans lequel
une zone de la plaque d'électrode de décharge (101)
est plus grande qu'une zone de la plaque d'électrode
de terre (104). 30
3. Lave-vaisselle selon la revendication 1, dans lequel
un appareil de séparation (107) est disposé dans
l'espace de stockage de vaisselle et est configuré
pour séparer la vaisselle. 35
4. Lave-vaisselle selon la revendication 1, dans lequel
une valeur d'une tension de décharge de l'alimenta-
tion électrique radiofréquence (105) est de 1 à 5 kV. 40
5. Lave-vaisselle selon la revendication 1, dans lequel
la plaque d'électrode de décharge (101) et la plaque
d'électrode de terre (104) sont respectivement cons-
tituées de matériaux conducteurs. 45
6. Procédé de commande d'un lave-vaisselle, dans le-
quel le procédé commande le lave-vaisselle selon
l'une quelconque des revendications 1 à 5, et com-
prend les étapes suivantes : 50

le placement de vaisselle dans un espace de
stockage de vaisselle formé entre une plaque
d'électrode de décharge (101) et une plaque
d'électrode de terre (104), dans lequel la vais-
selle sert de milieu isolant ;

l'électrification à des fins de stérilisation : l'application d'une tension à la plaque d'électrode de décharge (101) connectée à une alimentation électrique radiofréquence (105), pour former un champ électrique entre la plaque d'électrode de décharge (101) et la plaque d'électrode de terre (104) ; et 5

l'ionisation de l'air sur une surface du milieu isolant, pour former un plasma destiné à recouvrir la surface du milieu isolant. 10

7. Procédé de commande du lave-vaisselle selon la revendication 6,

dans lequel avant d'effectuer l'électrification à des fins de stérilisation, le procédé comprend en outre : le nettoyage de la vaisselle par le lave-vaisselle, 15

dans lequel après le nettoyage de la vaisselle par le lave-vaisselle, le procédé comprend en outre : le chauffage pour faire évaporer l'eau se trouvant sur la surface de la vaisselle. 20

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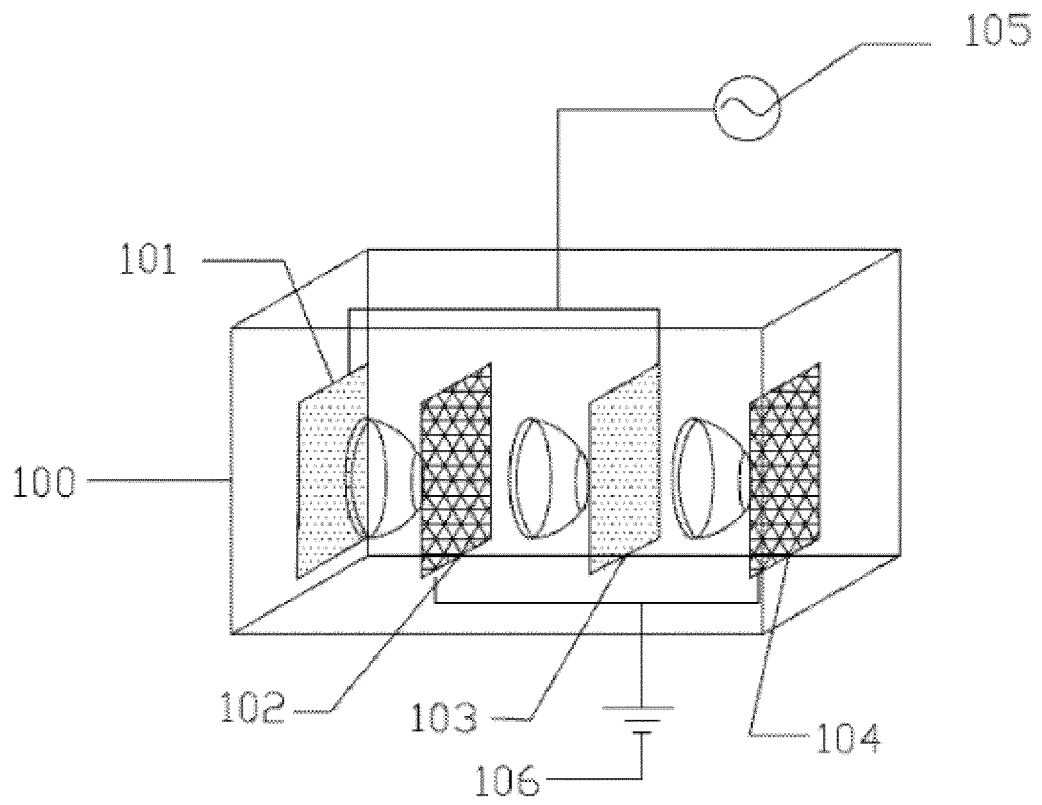


Fig. 1

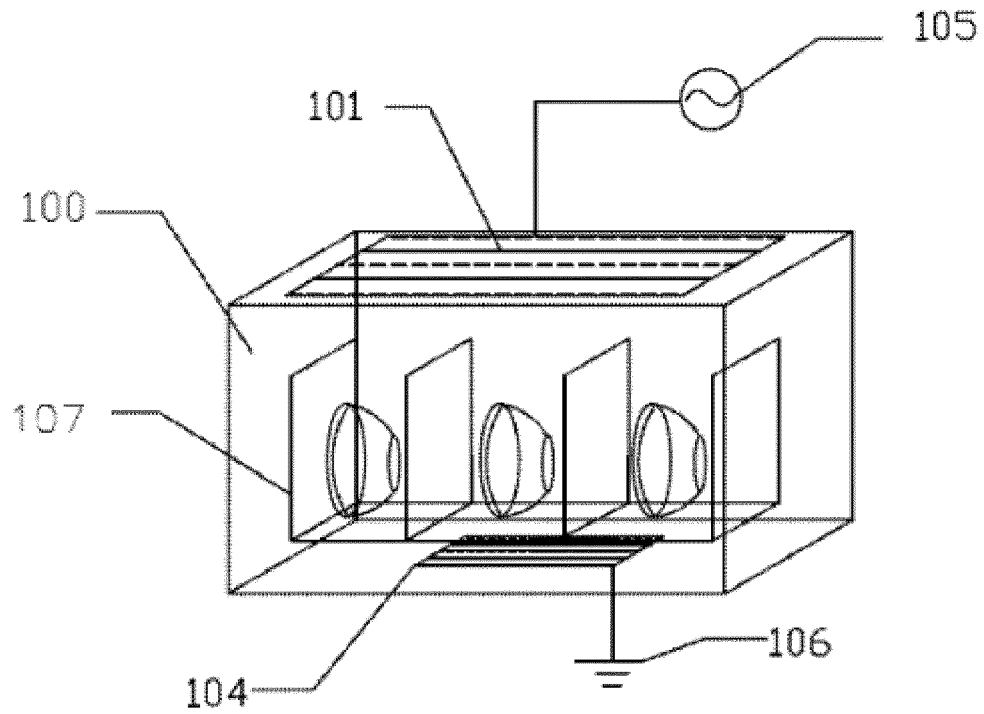


Fig. 2

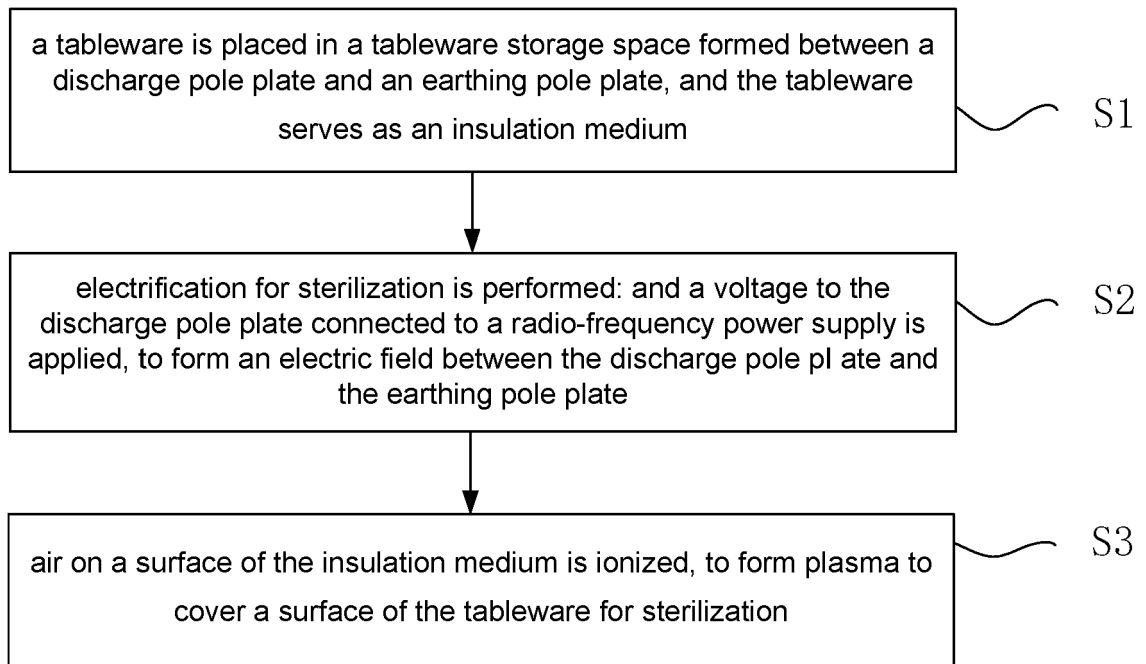


Fig. 3

REFERENCES CITED IN THE DESCRIPTION

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