UPPER ELECTRODE ASSEMBLY, REACTION CHAMBER AND ATOMIC LAYER DEPOSITION DEVICE

TECHNICAL FIELD

The present disclosure relates to the field of semiconductor manufacturing technology, and in particular, to an upper electrode assembly, a reaction chamber, and an atomic layer deposition device.

BACKGROUND

Currently, thin film deposition techniques are widely applied to devices in multiple fields, such as semiconductors, integrated circuits, solar panels, flat panel displays, microelectronics and light emitting diodes. The atomic layer deposition (ALD) technique is usually used in some thin film deposition processes to deposit a thin film, and has significant advantages over the other techniques because the film generated by the ALD process is very thin.

A plasma enhanced ALD (PE-ALD) process in the ALD technique can be used to manufacture various thin films. A capacitive PE-ALD process is to introduce two process gases which do not react with each other in normal conditions into a reaction chamber and perform an ALD process by adjusting a radio frequency (RF) period.

As shown in Fig. 1, an existing capacitive PE-ALD device includes a reaction chamber 100 and an upper electrode assembly which includes a shower plate 200 and a gas intake pipe 300. A gas inlet 400 of the gas intake pipe 300 is grounded, and a process gas sequentially passes through the gas intake pipe 300 and the shower plate 200 to enter the reaction chamber 100. The shower plate 200 is electrically connected to an RF power supply, and serves as an electrode plate to excite the process gas in the reaction chamber to generate plasma when the RF power supply is switched on.

In the process of implementing the present disclosure, the applicant finds that there are the following defects in the prior art:

since the gas inlet 400 of the gas intake pipe 300 is grounded and the shower plate 200 is electrically connected to the RF power supply, a potential difference is generated between the gas intake pipe 300 and the shower plate 200, and plasma is generated in the gas intake pipe 300 due to the potential difference, and then causes deposition of a conductive thin film on an inner wall of the gas intake pipe 300, which

results in a short circuit between the gas inlet 400 and the shower plate 200, and thus easily causes ignition.

SUMMARY

For at least partially solving the technical problems in the prior art, the present disclosure provides an upper electrode assembly, a reaction chamber and an atomic layer deposition device, which avoids generating a potential difference between a gas intake structure and an upper electrode plate, thereby effectively avoiding the ignition.

According to one aspect of the present disclosure, there is provided an upper electrode assembly, including a gas intake structure provided with a first channel, and an upper electrode plate provided with a second channel, the first channel is configured to introduce a process gas into the second channel, and the second channel is configured to introduce the process gas into a reaction chamber; and the upper electrode assembly further includes a gas intake isolation assembly disposed between the upper electrode plate and the gas intake structure and configured to electrically isolate an inner wall of the first channel from an inner wall of the second channel while introducing the process gas from the first channel into the second channel.

In some embodiments of the present disclosure, the gas intake isolation assembly includes an insulation member disposed between the upper electrode plate and the gas intake structure, and a middle channel is disposed in the insulation member; and

the middle channel is communicated with the first channel and the second channel respectively, and adopts a gas intake isolation structure which is configured to electrically isolate the inner wall of the first channel from the inner wall of the second channel.

In some embodiments of the present disclosure, the gas intake isolation assembly includes:

an insulation member disposed between the upper electrode plate and the gas intake structure and configured to electrically isolate the upper electrode plate from the gas intake structure; where a middle channel is disposed in the insulation member, and is communicated with the first channel and the second channel respectively; and

a gas intake isolation structure disposed in the middle channel and configured to electrically isolate the inner wall of the first channel from the inner wall of the second channel.

In some embodiments of the present disclosure, the gas intake isolation structure

includes at least one gas intake hole, and an axis of the gas intake hole is parallel to an axis of the middle channel; or a preset angle is formed between the axis of the gas intake hole and the axis of the middle channel.

In some embodiments of the present disclosure, a plurality of gas intake holes are provided, and the plurality of gas intake holes are distributed on at least one circumference taking the axis of the middle channel as a center; or the plurality of gas intake holes are arranged in an array relative to a radial section of the middle channel.

In some embodiments of the present disclosure, the gas intake isolation structure includes at least two gas intake hole groups, each including at least one gas intake hole; axes of the gas intake holes in the gas intake hole groups are parallel to an axis of the middle channel; or a preset angle is formed between the axis of the gas intake hole and the axis of the middle channel; and

the angles between the axes of the gas intake holes in different gas intake hole groups and the axis of the middle channel are different; and/or the gas intake holes in different gas intake hole groups have different radial section shapes.

In some embodiments of the present disclosure, the gas intake isolation structure includes two gas intake hole groups, which are a first gas intake hole group and a second gas intake hole group,

the first gas intake hole group includes a plurality of gas intake holes distributed on at least two first circumferences which take the axis of the middle channel as a center and have different radii; and each gas intake hole in the first gas intake hole group is a circular through hole; and

the second gas intake hole group includes a plurality of gas intake holes distributed on a second circumference taking the axis of the middle channel as a center; and each gas intake hole in the second gas intake hole group is a rectangular through hole, and a length of a radial section shape of the rectangular through hole is arranged along a radial direction of the second circumference.

In some embodiments of the present disclosure, the larger the radius of the first circumference where the gas intake holes in the first gas intake hole group are located, the larger the diameters of those gas intake holes.

In some embodiments of the present disclosure, the preset angle ranges from 30° to 89°.

In some embodiments of the present disclosure, the gas intake hole is a circular through hole; and a diameter of the circular through hole ranges from 0.5mm to 4mm.

In some embodiments of the present disclosure, a diameter of the circular through hole ranges from 0.5mm to 4mm.

In some embodiments of the present disclosure, an area of a radial section of the rectangular through hole ranges from $1mm^2$ to $20mm^2$.

In some embodiments of the present disclosure, the upper electrode plate is a shower plate provided with a spraying hole, and the axis of the gas intake hole and an axis of the spraying hole are staggered.

In some embodiments of the present disclosure, the upper electrode plate is a shower plate provided with a spraying hole, and the axes of the gas intake holes and an axis of the spraying hole are staggered.

According to another aspect of the present disclosure, there is provided a reaction chamber, including a chamber body and the above upper electrode assembly.

According to still another aspect of the present disclosure, there is provided an ALD device, including the above reaction chamber.

In the technical solutions of the upper electrode assembly, the reaction chamber and the ALD device provided by the present disclosure, the gas intake isolation assembly is disposed to block a path where the gas intake structure is in direct contact with the upper electrode plate and electrically isolate the inner wall of the first channel from the inner wall the second channel, so that no potential difference is generated between the gas intake structure and the upper electrode plate, thereby effectively avoiding the ignition.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objectives, technical features and advantages of the present disclosure will be more apparent through the following description of the embodiments of the present disclosure with reference to the accompanying drawings. In the drawings:

Fig. 1 is a schematic diagram of a capacitive PE-ALD device in the prior art;

Fig. 2 is a structural diagram of a section of an upper electrode assembly according to a first embodiment of the present disclosure;

Fig. 3 is a side view of a gas intake isolation structure used in the first embodiment of the present disclosure;

Fig. 4a and Fig. 4b are a three-dimensional structural diagram and a top view of a gas intake isolation structure according to the first embodiment of the present

disclosure, respectively;

Fig. 5 is another side view of a gas intake isolation structure used in the first embodiment of the present disclosure;

Fig. 6 is a still another side view of a gas intake isolation structure used in the first embodiment of the present disclosure;

Fig. 7 is a structural diagram of a section of an upper electrode assembly according to a second embodiment of the present disclosure;

Fig. 8a and Fig. 8b are a three-dimensional structural diagram and a top view of a gas intake isolation structure used in the second embodiment of the present disclosure, respectively;

Fig. 9 is a perspective view of a gas intake isolation structure used in the second embodiment of the present disclosure; and

Fig. 10 is a structural diagram of a section of a reaction chamber according to a third embodiment of the present disclosure.

Reference numerals:

[In the Prior Art]

100-reaction chamber; 200-shower plate; 300-gas intake pipe; 400-gas inlet.

[In the Present Disclosure]

10-gas intake structure; 101-first channel; 102-first branch channel; 103-second branch channel; 104-purging channel; 105-seal groove for gas intake manifold;

11-insulation member; 111-middle channel; 112-seal groove for insulation block;

12-gas intake isolation structure; 120, 120’-gas intake hole; 121-first gas intake hole; 122-second gas intake hole; Θ-preset angle;

2-upper electrode plate; 21-second channel; 22-radio frequency generator;

3-chamber body; 31-process reaction zone; 32-dispersion grid of process zone; 33-support base.

DETAILED DESCRIPTION

For solving at least one technical problem in the prior art, the present disclosure provides an upper electrode assembly, a reaction chamber and an ALD device. To make the objectives, technical solutions and advantages of the present disclosure more apparent, the present disclosure is further described in detail below with reference to the specific embodiments and the accompanying drawings. It should be understood

that these descriptions are merely illustrative and are not intended to limit the scope of the present disclosure. In addition, the description of well-known structures and techniques is omitted in the following description to avoid unnecessary confusion of the concepts of the present disclosure.

A first embodiment of the present disclosure provides an upper electrode assembly that can be applied to an ALD device, and in particular, to a capacitive PE-ALD device.

As shown in Fig. 2, an upper electrode assembly is disposed at the top of a reaction chamber of an ALD device, and includes a gas intake structure 10 and an upper electrode plate 2. The gas intake structure 10 is provided with a first channel 101, and is, in the embodiment, further provided with at least two branch channels. When the ALD device works, a precursor A and a precursor B pass through the two branch channels respectively to enter the first channel 101 at the same time, and are mixed together in the first channel 101, that is, the first channel 101 is used as a main pipe for mixing the precursor A and the precursor B and delivering a mixed gas of the precursor A and the precursor B. The precursor A and the precursor B are two process gases that do not react with each other in normal conditions.

The upper electrode plate 2 is provided with a second channel 21. The mixed gas of the precursor A and the precursor B is introduced into the second channel 21 through the first channel 101, and the second channel 21 is configured to introduce the mixed gas into the reaction chamber. In the embodiment, the upper electrode plate 2 is a shower plate. The shower plate is disposed at the top of the reaction chamber, and is connected to an RF generator 22 which is configured to apply RF power to the shower plate so as to excite the process gas in the reaction chamber to generate plasma. Moreover, the shower plate has a dispersion chamber, the dispersion chamber is provided at an upper end thereof with a central gas intake hole, and is provided at a lower end thereof with a plurality of spraying holes for uniformly discharging the process gas into the reaction chamber. The second channel 21 may be a hollow pipe that extends along an axis of the shower plate and is communicated with the central gas intake hole of the dispersion chamber; or the second channel 21 is the central gas intake hole of the dispersion chamber.

The upper electrode assembly further includes a gas intake isolation assembly which is disposed between the upper electrode plate 2 and the gas intake structure 10 and is configured to electrically isolate an inner wall of the first channel 101 from an

inner wall of the second channel 21 while introducing the process gas from the first channel 101 into the second channel 21. The electrical isolation refers to blocking a path where a positive electrode is in direct contact with a negative electrode, such that no current flows between the positive electrode and the negative electrode.

When a process is performed in the reaction chamber, the shower plate serves as a positive electrode, the gas intake structure 10 serves as a negative electrode, and a potential difference is easily generated between the shower plate and the gas intake structure if the first channel 101 is directly communicated with the second channel 21. In order to solve the problem, the gas intake isolation assembly is disposed between the upper electrode plate 2 and the gas intake structure 10 to block the path (indicated by the arrow in Fig. 2) where the positive electrode is in direct contact with the negative electrode and electrically isolate the inner wall of the first channel 101 from the inner wall of the second channel 21, so that the generation of the potential difference is prevented, thereby effectively avoiding the ignition. Meanwhile, the gas intake isolation assembly can allow the process gas to pass through, thereby enabling the introduction of the gas from the first channel 101 into the second channel 21 without affecting the flow of the gas.

The structure of the gas intake isolation assembly is described in detail below. Specifically, in the embodiment, the gas intake isolation assembly includes an insulation member 11 and a gas intake isolation structure 12. The insulation member 11 made of an insulation material is disposed between the upper electrode plate 2 and the gas intake structure 10, and is configured to electrically isolate the upper electrode plate 2 from the gas intake structure 10; and a middle channel 111 is provided in the insulation member 11, and is communicated with the first channel 101 and the second channel 21 respectively to introduce the gas from the first channel 101 into the second channel 21.

The gas intake isolation structure 12 is disposed in the middle channel 111, and is configured to electrically isolate the inner wall of the first channel 101 from the inner wall of the second channel 21, so as to avoid the generation of the potential difference.

Preferably, the gas intake structure 10, the insulation member 11 and the shower plate are disposed coaxially, and the first channel 101, the middle channel 111 and the second channel 21 are also disposed coaxially.

It should be noted that, in the embodiment, the gas intake isolation structure 12 is disposed in the middle channel 111 to ensure that there is enough space in the first

channel 101 for gas mixing, but the present disclosure is not limited thereto. In practical applications, the gas intake isolation structure 12 may be disposed in the first channel 101 or in both of the first channel 101 and the middle channel 111, as long as there is enough space in the first channel 101 for gas mixing.

It should be noted that, in the embodiment, the gas intake isolation structure 12 is a component independent of the insulation member 11, but the present disclosure is not limited thereto. In practical applications, the gas intake isolation structure 12 may be formed in the middle channel 111, that is, the middle channel 111 adopts the gas intake isolation structure 12, which can also electrically isolate the inner wall of the first channel 101 from the inner wall of the second channel 21.

In the embodiment, with reference to Fig. 3 to Fig. 4b, the gas intake isolation structure 12 includes a plurality of gas intake holes 120, and the axes of the plurality of gas intake holes 120 are parallel to an axis of the middle channel 111, so that the process gas can be introduced more smoothly.

Optionally, the plurality of gas intake holes 120 are arranged in an array relative to a radial section of the middle channel 111 so as to uniformly introduce the gas into the second channel 21. The array may be approximately a circular array, a square array, or the like. In practical applications, the plurality of gas intake holes 120 may also be distributed in any other way, for example, the plurality of gas intake holes 120 are distributed on at least one circumference taking the axis of the middle channel 111 as a center.

Optionally, in order to meet the requirement of gas flow, the number of the gas intake holes 120 is 20 to 200, preferably 80 to 170.

In the embodiment, all the gas intake holes 120 are circular through holes, and the diameters of the circular through holes range from 0.5mm to 4mm, preferably from 0.8mm to 3mm. With such diameter ranges, the inner wall of the first channel 101 can be electrically isolated from the inner wall of the second channel 21. The diameters of the gas intake holes 120 may be the same as or different from one another, or be partially the same.

It should be noted that, in the embodiment, all the gas intake holes 120 are circular through holes, but the present disclosure is not limited thereto. In practical applications, the radial sections of all the gas intake holes 120 may be in another shape, such as a square, an oval or a polygon. In addition, the gas intake holes 120 may include two or more types of gas intake holes that are different in the shapes of the

radial sections thereof.

It should be also noted that, in the embodiment, all the gas intake holes 120 are through holes, but the present disclosure is not limited thereto. In practical applications, the gas intake holes 120 may adopt a structure with different axial dimensions, such as tapered holes.

Optionally, a thickness of the gas intake hole 120 is about 2mm to 20mm, preferably 5mm to 15mm, e.g., 10mm.

Optionally, for a process which can be applied to a silicon wafer with a diameter of 12 inches, an inner diameter of the first channel 101 and that of the middle channel 111 are 6mm to 60mm, preferably 25mm to 45mm, and more preferably 30mm to 40mm, e.g., 38mm.

It should be noted that, in the embodiment, the axes of the plurality of gas intake holes 120 are parallel to the axis of the middle channel 111, but the present disclosure is not limited thereto. In practical applications, as shown in Fig. 5, a preset angle Θ is formed between the axes of the plurality of gas intake holes 120' and the axis of the middle channel 111. In this way, the inner wall of the first channel 101 can be electrically isolated from the inner wall of the second channel 21 in an effective way to avoid the ignition, and moreover, the process gas can generate a disklike field or a circulation field after passing through the oblique gas intake holes 120', so that the process gas can be fully mixed.

Optionally, the preset angle Θ is preferably 30° to 89°, and more preferably 60° to 80°.

A second embodiment of the present disclosure provides an upper electrode assembly. The technical features of the upper electrode assembly according to the second embodiment, which are the same as or similar to those of the upper electrode assembly according to the first embodiment, will not be repeated herein. Only the content of the second embodiment that is different from the first embodiment is described below.

In the embodiment, the gas intake isolation structure 12 includes at least two gas intake hole groups, each including at least one gas intake hole; an axis of the gas intake hole in the gas intake hole group is parallel to an axis of the middle channel 111; or a preset angle is formed between the axis of the gas intake hole and the axis of the middle channel 111. Moreover, the angles between the axes of the gas intake holes in different gas intake hole groups and the axis of the middle channel 111 are different;

and/or the gas intake holes in different gas intake hole groups have different radial section shapes. That is, the gas intake isolation structure 12 includes two or more gas intake hole groups which are different in the inclination angles and/or the radial section shapes of the gas intake holes.

For example, as shown in Fig. 6, the gas intake isolation structure 12 includes at least two gas intake hole groups, which include a first gas intake hole group and a second gas intake hole group. The first gas intake hole group include at least one first gas intake hole 121; and the second gas intake hole group include at least one second gas intake hole 122. An axis of the first gas intake hole 121 is parallel to the axis of the middle channel 111, and a preset angle Θ is formed between an axis of the second gas intake hole 122 and the axis of the middle channel 111. The preset angle Θ is preferably 30° to 89°, and more preferably 60° to 80°.

By setting two types of gas intake holes with different inclination angles, the inner wall of the first channel 101 can be electrically isolated from the inner wall of the second channel 21 in an effective way to avoid the ignition, and moreover, the process gas has different flow directions after passing through the first gas intake hole 121 and the second gas intake hole 122 respectively, so that the process gas can be mixed more fully.

Optionally, a radial section shape of the first gas intake hole 121 and that of the second gas intake hole 122 may be the same or different. In addition, the first gas intake hole 121 and the second gas intake hole 122 may be both circular through holes, which may have different diameters.

As another example, with reference to Figs. 7, 8a, 8b and 9, the gas intake isolation structure 12 includes at least two gas intake hole groups, which include a first gas intake hole group and a second gas intake hole group. The first gas intake hole group include a plurality of first gas intake holes 121, the first gas intake holes 121 are distributed on at least two first circumferences which take the axis of the middle channel 111 as a center and have different radii, and each of the first gas intake holes 121 is a circular through hole.

As shown in Fig. 8a and Fig. 8b, the plurality of first gas intake holes 121 are distributed on three first circumferences which take the axis of the middle channel 111 as a center and have different radii, and the three first circumferences are located in a central area, a middle area, and a peripheral area of the middle channel 111 respectively, such that the first gas intake holes 121 can be uniformly distributed along

a radial direction of the middle channel 111.

Optionally, a radial distance between two adjacent first circumferences is 3mm to 10mm, preferably 4mm to 8mm.

In practical applications, the number of the first gas intake holes 121 on each first circumference may be freely set according to specific requirements. Optionally, the number of the first gas intake holes 121 on the outermost first circumference is 5 to 20, preferably 8 to 15; and the number of the first gas intake holes 121 on the intermediate first circumference may be less than or equal to the number of the first gas intake holes 121 on the outermost first circumference. Optionally, the number of the first gas intake holes 121 on the intermediate first circumference is 5 to 20, preferably 8 to 15. The number of the first gas intake holes 121 on the innermost first circumference may be less than or equal to the number of the first gas intake holes 121 on the intermediate first circumference. Optionally, the number of the first gas intake holes 121 on the innermost first circumference is 1 to 8, preferably 2 to 6.

In practical applications, the diameters of the first gas intake holes 121 on each first circumference may be freely set according to specific requirements. Optionally, the larger the radius of the first circumference where the first gas intake holes 121 are located, the larger the diameters of those first gas intake holes 121. Specifically, the first gas intake holes 121 on the outermost first circumference have the largest diameters; and the first gas intake holes 121 on the innermost first circumference have the smallest diameters. In this way, the space of the gas intake isolation structure 12 can be fully utilized to increase the amount of the process gas passing through the gas intake isolation structure 12 per unit time, so that the process gas can pass through the gas intake isolation structure 12 more quickly.

In practical applications, the inclination angles of the first gas intake holes 121 on each first circumference may be freely set according to specific requirements. Specifically, the axes of the first gas intake holes 121 on each first circumference are parallel to the axis of the middle channel 111; or a preset angle Θ is formed between the axes of the first gas intake holes 121 on each first circumference and the axis of the middle channel 111. The preset angle Θ is preferably 30° to 89°, and more preferably 60° to 80°.

Moreover, the inclination angles of the first gas intake holes 121 on the same first circumference may be the same or different. The inclination angles of the first gas intake holes 121 on different first circumferences may be the same or different.

It should be noted that, in the embodiment, the first gas intake holes 121 are circular through holes, but the present disclosure is not limited thereto. In practical applications, the radial section shapes of the first gas intake holes 121 may be a square, an oval, or a polygonal.

As shown in Figs. 8a, 8b and 9, the second gas intake hole group include a plurality of second gas intake holes 122 which are distributed on a second circumference taking the axis of the middle channel 111 as a center; and each of the second gas intake holes 122 is a rectangular through hole, and a length of a radial section shape of the rectangular through hole is arranged along a radial direction of the second circumference. In practical applications, the radial section shape of the second gas intake hole 122 may be an elongated oval, or a quasi-rectangular with round corners.

Further, in the embodiment, one second gas intake hole 122 is disposed between any two adjacent first gas intake holes 121 on the outermost first circumference and between two adjacent first gas intake holes 121 on the intermediate first circumference corresponding to the two adjacent first gas intake holes 121 on the outermost first circumference. Moreover, the first gas intake holes 121 on the innermost first circumference are all located on the inner sides of the inner ends of the second gas intake holes 122. In this way, the first gas intake holes 121 and the second gas intake holes 122 can be alternately arranged along a circumferential direction of the middle channel 111, which enables full mixing of the process gas.

Optionally, the second gas intake hole 122 is a rectangular through hole, and an area of the radial section thereof ranges from $1mm^2$ to $20mm^2$, preferably from $5mm^2$ to $15mm^2$.

In practical applications, the inclination angles of the second gas intake holes 122 may be freely set according to specific requirements. Specifically, the axes of the second gas intake holes 122 (parallel to the axis of the middle channel) and the axis of the middle channel 111 are parallel to one another; or a preset angle Θ is formed between the axes of the second gas intake holes 122 and the axis of the middle channel 111. The preset angle Θ is preferably 30° to 89 °, and more preferably 60° to 80°.

An example of the upper electrode assembly according to each of the above embodiments is illustrated below with reference to Fig. 2 and Fig. 3. The gas intake isolation structure 12 is embedded in the middle channel 111, and a radial section shape of the middle channel 111 is circular. Furthermore, the middle channel 111 is

divided into an inlet section and a body section communicated with the inlet section along a direction extending from the first channel 101 to the second channel 21, and a diameter of the inlet section is larger than that of the body section. The gas intake isolation structure 12 includes a cylindrical body divided into a first section and a second section along an axis thereof, and an outer diameter of the first section is larger than that of the second section. In addition, an outer wall of the first section matches an inner wall of the inlet section of the middle channel 111, and an outer wall of the second section matches an inner wall of the body section of the middle channel 111, so that the gas intake isolation structure 12 can be embedded in the middle channel 111. In this way, it is convenient to position, install, disassemble, and clean the gas intake isolation structure 12.

In addition, a radial section shape of the first channel 101 is also circular, and a diameter of the first channel 101 is smaller than the outer diameter of the first section of the gas intake isolation structure 12, so that the gas intake structure 10 can press the gas intake isolation structure 12, which facilitates improving the firmness of installation.

Another embodiment of the present disclosure provides a reaction chamber which includes a chamber body 3 and the upper electrode assembly according to any one of the above embodiments.

As shown in Fig. 10, a support base 33 is disposed at the bottom of the chamber body 3 and is grounded, has a heating function, and is configured to support and heat a substrate.

The chamber body 3, the shower plate of the upper electrode assembly and the support base 33 form a process reaction zone 31 for realizing an ALD process. A dispersion grid of process zone 32 is disposed on a portion of a side wall of the chamber body 3, which constitutes the process reaction zone 31, and is configured to improve the uniformity of the flow of the process gas.

The first channel 101, a first branch channel 102, a second branch channel 103 and a purging channel 104 are provided on a side wall of the gas intake structure 10, and the first branch channel 102, the second branch channel 103 and the purging channel 104 are all communicated with the first channel 101. In one example, the first branch channel 102, the second branch channel 103, and the purging channel 104 are located at different positions on the side wall of the gas intake structure 10 along a circumferential direction thereof, and are all located at the same height. A seal groove

for insulation block 112 is disposed on an upper surface of the shower plate, and the insulation member 11 and the shower plate are sealed by a seal ring in the seal groove for insulation block 112. A seal groove for gas intake manifold 105 is disposed on a lower surface of the gas intake structure 10, and the gas intake structure 10 and an insulation block are sealed by a seal ring in the seal groove for gas intake manifold 105.

The precursor A passes through the first branch channel 102 to enter the first channel 101, the precursor B passes through the second branch channel 103 to enter the first channel 101, and the precursors A and B enter the process reaction zone 31 of the chamber body 3 after entering the reaction chamber. In the process reaction zone 31, the precursor A is adsorbed to a surface of the substrate. Then an inert gas passes through the purging channel 104 to enter the first channel 101, and passes through the gas intake isolation structure, the middle channel 111 and the shower plate to enter the process reaction zone 31 to purge the residual precursor A. Finally, the RF generator 22 is switched on to generate plasma of the precursor B, and the plasma reacts with the precursor A on the surface of the substrate to form a thin film. The above steps are repeated continuously during the whole process to deposit a thin film repeatedly on the substrate until a thickness of the obtained thin film meets process requirements.

Still another embodiment of the present disclosure provides an ALD device, and more particularly, a capacitive PE-ALD device, including the reaction chamber provided by the above embodiment.

The objectives, technical solutions and beneficial effects of the present disclosure are further illustrated in detail by the above specific embodiments. However, it should be understood that what is described above is only specific embodiments of the present disclosure, and is not intended to limit the present disclosure. Any modification, equivalent, and improvement made within the spirit and principle of the present disclosure should be included within the protection scope of the present disclosure.

It should be noted that the terms used in the embodiments to indicate directions, such as “upper”, “lower”, “front”, “back”, “left” and “right”, only indicate the directions with reference to the drawings, and are not intended to limit the protection scope of the present disclosure. The same elements are represented by the same or similar reference numerals throughout the drawings. Conventional structures or configurations are omitted when a misunderstanding of the present disclosure may be caused.

Unless otherwise indicated, numerical parameters provided in the description and appended claims are approximations that may vary according to the required properties obtained by the present disclosure. Specifically, it should be understood that all the numbers representing content of components or reaction conditions in the description and claims are modified by the word “about” in all circumstances. In general, the numbers mean that variations of a specified number by ±10%, ±5%, ±1%, or ±0.5% in some embodiments are included.

Furthermore, the word “include” does not exclude an element or a step that is not listed in the claims. The word “a” or “an” before an element does not exclude that there are a plurality of such elements.

Ordinal numbers in the description and claims, such as “first”, “second” and “third”, are intended to modify corresponding elements, but do not imply or indicate that the modified element has any ordinal number. Furthermore, the ordinal numbers do not indicate an order of the elements or an order of the manufacturing processes of the elements, but are only intended to distinguish between two elements having the same name.

Similarly, it should be understood that, in order to simplify the present disclosure and help understand one or more aspects of the present disclosure, the technical features of the present disclosure are sometimes grouped together in a single embodiment, drawing, or description thereof in the above description of the exemplary embodiments of the present disclosure. However, the method of present disclosure should not be interpreted as reflecting the intention that the claimed disclosure requires more features than those explicitly recorded in each claim. More precisely, as reflected in the following claims, a disclosed aspect is less than all the technical features of the previously disclosed single embodiment. Therefore, the claims according to the detailed description hereby are explicitly incorporated into the detailed description, with each claim itself being regarded as a single embodiment of the present disclosure.

What is claimed is:

1. An upper electrode assembly, comprising a gas intake structure provided with a first channel, and an upper electrode plate provided with a second channel, wherein the first channel is configured to introduce a process gas into the second channel, and the second channel is configured to introduce the process gas into a reaction chamber; and wherein the upper electrode assembly further comprises a gas intake isolation assembly disposed between the upper electrode plate and the gas intake structure and configured to electrically isolate an inner wall of the first channel from an inner wall of the second channel while introducing the process gas from the first channel into the second channel;

the gas intake isolation assembly comprises:

an insulation member disposed between the upper electrode plate and the gas intake structure and configured to electrically isolate the upper electrode plate from the gas intake structure; wherein a middle channel is disposed in the insulation member, and is communicated with the first channel and the second channel respectively; and

a gas intake isolation structure disposed in the middle channel and configured to electrically isolate the inner wall of the first channel from the inner wall of the second channel; and

the gas intake isolation structure comprises two or more gas intake hole groups which are different in inclination angles of gas intake holes; each gas intake hole group comprises at least one gas intake hole; a preset angle is formed between an axis of the gas intake hole in one of at least two gas intake hole groups and the axis of the middle channel.

2. The upper electrode assembly of claim 1, wherein all the gas intake holes of the two or more gas intake hole groups are distributed on at least one circumference taking the axis of the middle channel as a center; or all the gas intake holes of the two or more gas intake hole groups are arranged in an array relative to a radial section of the middle channel.

3. The upper electrode assembly of claim 1, wherein the gas intake holes in different gas intake hole groups have different radial section shapes.

4. The upper electrode assembly of claim 3, wherein the gas intake isolation

structure comprises two gas intake hole groups, which are a first gas intake hole group and a second gas intake hole group, wherein,

the first gas intake hole group comprises a plurality of gas intake holes distributed on at least two first circumferences which take the axis of the middle channel as a center and have different radii; and each gas intake hole in the first gas intake hole group is a circular through hole; and

the second gas intake hole group comprises a plurality of gas intake holes distributed on a second circumference taking the axis of the middle channel as a center; and each gas intake hole in the second gas intake hole group is a rectangular through hole, and a length of a radial section shape of the rectangular through hole is arranged along a radial direction of the second circumference.

5. The upper electrode assembly of claim 4, wherein the larger the radius of the first circumference where the gas intake holes in the first gas intake hole group are located, the larger the diameters of those gas intake holes.

6. The upper electrode assembly of claim 1, wherein the preset angle ranges from 30° to 89°.

7. The upper electrode assembly of claim 3, wherein the preset angle ranges from 30° to 89°.

8. The upper electrode assembly of claim 1, wherein all the gas intake holes of the two or more gas intake hole groups are circular through holes; and diameters of the circular through holes range from 0.5mm to 4mm.

9. The upper electrode assembly of claim 4, wherein a diameter of the circular through hole ranges from 0.5mm to 4mm.

10. The upper electrode assembly of claim 4, wherein an area of a radial section of the rectangular through hole ranges from $1mm^2$ to $20mm^2$.

11. The upper electrode assembly of claim 1, wherein the upper electrode plate is a shower plate provided with a spraying hole, and the axis of the gas intake hole and an

axis of the spraying hole are staggered.

12. The upper electrode assembly of claim 3, wherein the upper electrode plate is a shower plate provided with a spraying hole, and the axes of the gas intake holes and an axis of the spraying hole are staggered.

13. A reaction chamber, comprising the upper electrode assembly of any one of claims 1 to 12.

14. An atomic layer deposition device, comprising the reaction chamber of claim 13.