

METHOD OF FASTENING 12-INCH SILICON ELECTRODE USED IN
SEMICONDUCTOR ETCHING PROCESS EQUIPMENT

CROSS REFERENCE TO RELATED APPLICATION

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The present application claims priority to Korean Patent Application No. 10-2021-0139822, filed October 19, 2021, the entire contents of which is incorporated herein for all purposes by this reference.

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BACKGROUND OF THE INVENTION

Field of the Invention

The present disclosure relates generally to a method of
15 fastening a 12-inch silicon electrode used in semiconductor etching process equipment. More particularly, the present disclosure relates to a method of fastening a 12-inch silicon electrode used in semiconductor etching process equipment, in which a fastening structure of a silicon electrode used in a
20 12-inch silicon etching process in a chamber of the semiconductor etching process equipment is improved.

Description of the Related Art

In general, an etching process in semiconductor
25 fabrication is the process of removing unnecessary portions

while leaving necessary portions in the process of forming a circuit pattern on a substrate, and may be divided into wet etching and dry etching. Wet etching is an isotropic etching technique that uses a chemical reaction (solution), and has
5 advantages of low cost and being an easy process. However, there is a contradictory problem in that accurate etching is difficult to achieve and contamination is caused by chemicals. In particular, wet etching has a limitation in forming fine patterns due to etching errors, and thus is difficult to apply
10 to semiconductor products such as high-density integrated circuits.

Dry etching is used to solve such a problem. Dry etching is an etching technique that forms a circuit pattern by using reactant gas particles in a plasma state. This plasma etching
15 method has advantages of enabling accurate and precise anisotropic etching, and thus is widely used in fabrication of micro-patterned substrates such as high-density integrated circuits.

A silicon electrode used in a dry etching apparatus using
20 plasma is configured by bonding silicon (gas shower head) and graphite (bonding body). These two components, silicon and graphite, are bonded using a non-conductive elastomer. This bonding technique is implemented by evenly spraying the non-conductive elastomer on the graphite (bonding body), pressing
25 the silicon (gas shower head) from above to be bonded, and

performing curing by high-temperature heat treatment.

In order to measure a bonding strength between the silicon and the graphite, two components of the silicon electrode thus implemented, a load test of 300 kg was conducted, with the
5 result that the bonding body was separated. Thus, when the silicon electrode is applied to semiconductor etching process equipment, the silicon electrode may be accidentally detached during the operation of the equipment due to lack of the bonding strength. This is problematic because not only the
10 silicon electrode, but also other components may be damaged. In other words, the detachment of the silicon electrode used in a semiconductor etching process may cause damage to a wafer, leading to enormous economic and process losses.

Meanwhile, the types of the silicon electrode include a
15 first-generation-GBE, a second-generation-PRK 2 GBE, a third-generation-ABE, and a fourth-generation single-piece type. A 12-inch silicon electrode used in the dry etching apparatus is composed of two types, an inner silicon electrode and an outer silicon electrode. The inner silicon electrode is a graphite
20 bonding electrode formed by bonding silicon and graphite (bonding body) using an elastomer resin (adhesive).

When a 12-inch GBE silicon electrode is fastened to a back plate of a chamber, the fastening is achieved by creating a helical coil in graphite. Therefore, there is a problem in
25 that in the course of a plasma temperature cycle, particles are

generated due to interference between graphite and the helical coil therein and due to interference between silicon and graphite (bonding body).

To solve such a problem, an attempt has been made to prevent particle issues by forming a gas hole in silicon with a distance from the helical coil while adopting an existing silicon-graphite bonding structure. However, the problem of particle generation due to interference between silicon and graphite (bonding body) is still not solved. In the case of ABE in which aluminum is used instead of graphite (bonding body) to eliminate the problem of graphite (bonding body), aluminum inherently has a high coefficient of thermal expansion, and such a high coefficient of thermal expansion is not a good condition for bonding. Also, there is a problem in that plasma affects a bonding agent on a bonded portion due to occurrence of electrical arcing between silicon and aluminum (bonding body) and deformation of an outer shape, causing particles to be generated.

As an alternative to the ABE, a single piece made of only silicon has been proposed. However, when fixing and fastening this, a graphite bushing and a metal helical coil have to be used, and there is a problem in that the graphite bushing with a small area causes cracks and particles, resulting in fastening and process problems.

SUMMARY OF THE INVENTION

Accordingly, the present disclosure has been made keeping in mind the above problems occurring in the related art, and an objective of the present disclosure is to provide a method of fastening a 12-inch silicon electrode used in semiconductor etching process equipment, in which a fastening structure of a silicon electrode is improved, the silicon electrode being used to evenly distribute plasma on a wafer surface in order to obtain a uniform etching rate over the entire surface of a 12-inch wafer in a chamber of the semiconductor etching process equipment, and the fastening of the silicon electrode is achieved in such a manner that a bushing made of engineering plastic and Torlon materials is fastened and fixed to the silicon electrode, then the silicon electrode is positioned and placed on a back plate of the semiconductor etching process equipment to fasten the silicon electrode to which the bushing is fastened and fixed, and the back plate and the silicon electrode are fastened and fixed through a bushing fastening screw. Therefore, by the use of engineering plastic and Torlon materials in a silicon-graphite bushing fastening process, it is possible to solve the problems of particle generation and strong fastening pressure, and thereby prevent accidental detachment of the silicon electrode caused by lack of bonding strength during the operation of the equipment.

Another objective of the present disclosure is to provide a method of fastening a 12-inch silicon electrode used in semiconductor etching process equipment, in which by an improved fastening structure of a silicon electrode in which
5 the silicon electrode is fastened and fixed by the engagement between a bushing made of engineering plastic and Torlon materials and a bushing fastening screw, it is possible to stably maintain bonding strength, prevent particle generation, and further improve durability and dimensional stability
10 through excellent heat resistance, excellent strength, and excellent dimensional processability of engineering plastic and Torlon materials.

In order to achieve the above objectives, according to one aspect of the present disclosure, there is provided a method of
15 fastening a 12-inch silicon electrode used in semiconductor etching process equipment.

The method of fastening the 12-inch silicon electrode used in the semiconductor etching process equipment may include: (1) forming a plurality of bushing tabs on a silicon electrode to
20 fasten the silicon electrode used in the semiconductor etching process equipment and fastening a plurality of bushings to the plurality of bushing tabs, respectively; (2) positioning and placing the silicon electrode on a back plate of the semiconductor etching process equipment to fasten the silicon
25 electrode to which the plurality of bushings are fastened and

fixed in step (1); and (3) fastening and fixing the back plate and the silicon electrode through a bushing fastening screw in a state in which the silicon electrode is positioned and placed on the back plate in step (2).

5 Preferably, in step (1), the plurality of bushings may be fastened and fixed to the plurality of bushing tabs formed on the silicon electrode to fasten the silicon electrode used in the semiconductor etching process equipment, the plurality of bushings may be made of Torlon or engineering plastic.

10 Preferably, in step (1), the plurality of bushings may be fastened and fixed to the plurality of bushing tabs formed on the silicon electrode to fasten the silicon electrode used in the semiconductor etching process equipment, the plurality of bushings may be made of engineering plastic.

15 Preferably, the silicon electrode may be a 12-inch silicon electrode used in the semiconductor etching process equipment, and may be composed of one set of an inner silicon electrode to which the bushings for fastening to the back plate are fastened and fixed and an outer silicon electrode.

20 More preferably, the silicon electrode may be is composed of one set of the inner silicon electrode to which the bushings for fastening to the back plate of the semiconductor etching process equipment are fastened and fixed and the outer silicon electrode, and a screw thread for screwing with a bushing may
25 be formed by machining an inner diameter of each of the bushing

tabs for fastening and fixing the bushings.

More preferably, each of the bushings may be fastened to each of the bushing tabs of the silicon electrode used in the semiconductor etching process equipment, and may have a screw
5 thread on an outer diameter surface thereof and a bushing tab on an inner diameter surface thereof so that the bushing may be inserted and fastened to the bushing tab of the silicon electrode.

Even more preferably, each of the bushings may be fastened
10 to each of the bushing tabs of the silicon electrode used in the semiconductor etching process equipment and may be fastened to the silicon electrode by applying a bonding agent free of contamination and having strong adhesive force on the outer diameter surface thereof on which the screw thread is formed.

Even more preferably, each of the bushings may be fastened
15 to each of the bushing tabs of the silicon electrode used in the semiconductor etching process equipment and may be fastened to the silicon electrode without applying a bonding agent free of contamination and having strong adhesive force on the outer
20 diameter surface thereof on which the screw thread is formed.

According to the method of fastening the 12-inch silicon electrode used in the semiconductor etching process equipment, a fastening structure of a silicon electrode is improved, the silicon electrode being used to evenly distribute plasma on a
25 wafer surface in order to obtain a uniform etching rate over

the entire surface of a 12-inch wafer in a chamber of the semiconductor etching process equipment, and the fastening of the silicon electrode is achieved in such a manner that a bushing made of engineering plastic and Torlon materials is fastened and fixed to the silicon electrode, then the silicon electrode is positioned and placed on a back plate of the semiconductor etching process equipment to fasten the silicon electrode to which the bushing is fastened and fixed, and the back plate and the silicon electrode are fastened and fixed through a bushing fastening screw. Therefore, by the use of engineering plastic and Torlon materials in a silicon-graphite bushing fastening process, it is possible to solve the problems of particle generation and strong fastening pressure, and thereby prevent accidental detachment of the silicon electrode caused by lack of bonding strength during the operation of the equipment.

Furthermore, according to the method of fastening the 12-inch silicon electrode used in the semiconductor etching process equipment, by the improved fastening structure of the silicon electrode in which the silicon electrode is fastened and fixed by the engagement between the bushing made of engineering plastic and Torlon materials and the bushing fastening screw, it is possible to stably maintain bonding strength, prevent particle generation, and further improve durability and dimensional stability through excellent heat

resistance, excellent strength, and excellent dimensional processability of engineering plastic and Torlon materials.

BRIEF DESCRIPTION OF THE DRAWINGS

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The above and other objectives, features, and other advantages of the present disclosure will be more clearly understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

10 FIG. 1 is a flowchart illustrating a method of fastening a 12-inch silicon electrode used in semiconductor etching process equipment according to an embodiment of the present disclosure;

 FIG. 2 is a functional block diagram illustrating the configuration of a silicon electrode used in the method of
15 fastening the 12-inch silicon electrode used in the semiconductor etching process equipment according to the embodiment of the present disclosure;

 FIG. 3 is a functional block diagram illustrating a schematic overall configuration of the method of fastening the
20 12-inch silicon electrode used in the semiconductor etching process equipment according to the embodiment of the present disclosure;

 FIG. 4 is a view illustrating a schematic overall configuration of the method of fastening the 12-inch silicon
25 electrode used in the semiconductor etching process equipment

according to the embodiment of the present disclosure;

FIG. 5 is a view illustrating the configuration of the bottom of a back plate used in the method of fastening the 12-inch silicon electrode used in the semiconductor etching process equipment according to the embodiment of the present disclosure;

FIG. 6 is a view illustrating the configuration of an inner silicon electrode and an outer silicon electrode used in the method of fastening the 12-inch silicon electrode used in the semiconductor etching process equipment according to the embodiment of the present disclosure; and

FIG. 7 is a view illustrating the configuration of a bushing used in the method of fastening the 12-inch silicon electrode used in the semiconductor etching process equipment according to the embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, an exemplary embodiment of the present disclosure will be described in detail with reference to the accompanying drawings such that the present disclosure can be easily embodied by one of ordinary skill in the art to which the present disclosure belongs. In the following description of the present disclosure, detailed descriptions of known functions and components incorporated herein will be omitted

when it may make the gist of the present disclosure unclear. The same reference numerals are used throughout the different drawings to designate the same or similar components.

It will be understood that when an element is referred to
5 as being "coupled" or "connected" to another element, it can be directly coupled or connected to the other element or intervening elements may be present therebetween. It will be further understood that the terms "comprise", "include", "have", etc. when used herein, specify the presence of stated
10 features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

FIG. 1 is a flowchart illustrating a method of fastening a
15 12-inch silicon electrode used in semiconductor etching process equipment according to an embodiment of the present disclosure. As illustrated in FIG. 1, the method of fastening the 12-inch silicon electrode used in the semiconductor etching process equipment according to the embodiment of the present disclosure
20 may include: forming a plurality of bushing tabs on a silicon electrode 100 to fasten the silicon electrode 100 used in the semiconductor etching process equipment and fastening a plurality of bushings 110 to the plurality of bushing tabs, respectively (S110); positioning and placing the silicon
25 electrode 100 on a back plate 200 of the semiconductor etching

process equipment to fasten the silicon electrode 100 to which the plurality of bushings 110 are fastened and fixed in step S110 (S120); and fastening and fixing the back plate 200 and the silicon electrode 100 through a bushing fastening screw 300
5 in a state in which the silicon electrode 100 is positioned and placed on the back plate 200 in step S120 (S130). Hereinafter, the method of fastening the 12-inch silicon electrode used in the semiconductor etching process equipment according to the embodiment of the present disclosure will be described in
10 detail with reference to the accompanying drawings.

FIG. 2 is a functional block diagram illustrating the configuration of the silicon electrode 100 used in the method of fastening the 12-inch silicon electrode used in the semiconductor etching process equipment according to the
15 embodiment of the present disclosure. FIG. 3 is a functional block diagram illustrating a schematic overall configuration of the method of fastening the 12-inch silicon electrode used in the semiconductor etching process equipment according to the embodiment of the present disclosure. FIG. 4 is a view
20 illustrating a schematic overall configuration of the method of fastening the 12-inch silicon electrode used in the semiconductor etching process equipment according to the embodiment of the present disclosure;

In step S110, the plurality of bushing tabs are formed on
25 the silicon electrode 100 to fasten the silicon electrode 100

used in the semiconductor etching process equipment, and the plurality of bushings 110 are fastened to the plurality of bushing tabs, respectively. In step S110, the plurality of bushings 110 may be fastened and fixed to the plurality of bushing tabs formed on the silicon electrode 100 to fasten the silicon electrode 100 used in the semiconductor etching process equipment, and the plurality of bushings 110 may be made of engineering plastic and Torlon. Here, in step S110, the plurality of bushings 110 may be fastened and fixed to the plurality of bushing tabs formed on the silicon electrode 100 to fasten the silicon electrode 100 used in the semiconductor etching process equipment, and the plurality of bushings 110 may be made of engineering plastic. In this case, the engineering plastic may include, for example, polycarbonate (PC), modified polyphenylene oxide (mPPO), nylon, polyacetal (POM), and polybutylene terephthalate (PBT).

In addition, the silicon electrode 100 is a 12-inch silicon electrode used in the semiconductor etching process equipment, and as illustrated in FIG. 2, may be composed of one set of an inner silicon electrode 120 to which the bushings 110 for fastening to the back plate 200 are fastened and fixed and an outer silicon electrode 130.

In addition, the silicon electrode 100 may be composed of one set of the inner silicon electrode 120 to which the bushings 110 for fastening to the back plate 200 of the

semiconductor etching process equipment are fastened and fixed and the outer silicon electrode 130, and a screw thread for screwing with a bushing 110 may be formed by machining an inner diameter of each of the bushing tabs for fastening and fixing
5 the bushings 110.

In addition, each of the bushings 110 may be fastened to each of the bushing tabs of the silicon electrode 100 used in the semiconductor etching process equipment, and may have a screw thread on an outer diameter surface thereof and a bushing
10 tab on an inner diameter surface thereof so that the bushing 110 is inserted and fastened to the bushing tab.

In addition, each of the bushings 110 may be fastened to each of the bushing tabs of the silicon electrode 100 used in the semiconductor etching process equipment, and may be
15 fastened to the silicon electrode 100 by applying a bonding agent free of contamination and having strong adhesive force on the outer diameter surface thereof on which the screw thread is formed. Here, as an example of the bonding agent that is free of contamination and has strong adhesive force, an elastomer
20 bonding solution may be used.

In addition, each of the bushings 110 may be fastened to each of the bushing tabs of the silicon electrode 100 used in the semiconductor etching process equipment, and may be fastened to the silicon electrode 100 without applying the
25 bonding agent free of contamination and having strong adhesive

force on the outer diameter surface thereof on which the screw thread is formed.

In step S120, the silicon electrode 100 may be positioned and placed on the back plate 200 of the semiconductor etching process equipment to fasten the silicon electrode 100 to which the plurality of bushings 110 are fastened and fixed in step S110.

In step S130, in a state in which the silicon electrode 100 is positioned and placed on the back plate 200 in step S120, the back plate 200 and the silicon electrode 100 are fastened and fixed through the bushing fastening screw 300. In step S130, in a state in which the bushings 110 made of engineering plastic and Torlon are formed on the inner silicon electrode 120 and the outer silicon electrode 130, the back plate 200 and the silicon electrode 100 may be fastened through the bushing fastening screw 300. In other words, the bushing fastening screw 300 is fastened to the silicon electrode 100 by passing through a screw hole at the bottom of the back plate 200. Here, the bushing fastening screw 300 may be a general screw.

In addition, the 12-inch silicon electrode 100 has a plurality of gas holes or other gas holes with a uniform interval and size so as to allow gas to uniformly flow.

FIG. 5 is a view illustrating the configuration of the bottom of the back plate 200 used in the method of fastening

the 12-inch silicon electrode used in the semiconductor etching process equipment according to the embodiment of the present disclosure. FIG. 6 is a view illustrating the configuration of the inner silicon electrode 120 and the outer silicon electrode
5 130 used in the method of fastening the 12-inch silicon electrode used in the semiconductor etching process equipment according to the embodiment of the present disclosure. FIG. 7 is a view illustrating the configuration of the bushing 110 used in the method of fastening the 12-inch silicon electrode
10 used in the semiconductor etching process equipment according to the embodiment of the present disclosure.

As described above, when used in a dry etching process in a semiconductor etching process, the silicon electrode 100 manufactured by the method of fastening the 12-inch silicon
15 electrode used in the semiconductor etching process equipment according to the embodiment of the present disclosure is used to evenly distribute plasma on a wafer surface in order to obtain a uniform etching rate over the entire surface of a 12-inch wafer in a chamber of the semiconductor etching process
20 equipment. Here, the inner silicon electrode 120 and the outer silicon electrode 130 of the silicon electrode 100 serve as gas shower heads, have a size corresponding to the wafer of the semiconductor etching process equipment, and have a plurality of gas holes or other gas holes with a uniform interval and
25 size so as to allow gas to uniformly flow.

As described above, according to the method of fastening the 12-inch silicon electrode used in the semiconductor etching process equipment according to the embodiment of the present disclosure, a fastening structure of the silicon electrode is improved, the silicon electrode being used to evenly distribute the plasma on the wafer surface in order to obtain the uniform etching rate over the entire surface of the 12-inch wafer in the chamber of the semiconductor etching process equipment, and the fastening of the silicon electrode is achieved in such a manner that the bushing made of engineering plastic and Torlon materials is fastened and fixed to the silicon electrode, then the silicon electrode is positioned and placed on the back plate of the semiconductor etching process equipment to fasten the silicon electrode to which the bushing is fastened and fixed, and the back plate and the silicon electrode are fastened and fixed through the bushing fastening screw. Therefore, by the use of engineering plastic and Torlon materials in a silicon-graphite bushing fastening process, it is possible to solve the problems of particle generation and strong fastening pressure, and thereby prevent accidental detachment of the silicon electrode caused by lack of bonding strength during the operation of the equipment. In particular, by the improved fastening structure of the silicon electrode in which the silicon electrode is fastened and fixed by the engagement between the bushing made of engineering plastic and

Torlon materials and the bushing fastening screw, it is possible to stably maintain bonding strength, prevent particle generation, and further improve durability and dimensional stability through excellent heat resistance, excellent strength, and excellent dimensional processability of engineering plastic and Torlon materials.

Although a preferred embodiment of the present disclosure has been described for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the present disclosure as disclosed in the accompanying claims.

<Description of the Reference Numerals in the Drawings>

- 100: silicon electrode
- 110: bushing
- 120: inner silicon electrode
- 130: outer silicon electrode
- 200: back plate
- 300: bushing fastening screw
- S110: forming plurality of bushing tabs on silicon electrode, and fastening plurality of bushings to plurality of bushing tabs, respectively
- S120: positioning and placing silicon electrode on back plate
- S130: fastening and fixing back plate and silicon

electrode through bushing fastening screw

WHAT IS CLAIMED IS:

1. A method of fastening a 12-inch silicon electrode used in semiconductor etching process equipment, the method
5 comprising:

(1) forming a plurality of bushing tabs on a silicon electrode (100) to fasten the silicon electrode (100) used in the semiconductor etching process equipment and fastening a plurality of bushings (110) to the plurality of bushing tabs,
10 respectively;

(2) positioning and placing the silicon electrode (100) on a back plate (200) of the semiconductor etching process equipment to fasten the silicon electrode (100) to which the plurality of bushings (110) are fastened and fixed in step (1);
15 and

(3) fastening and fixing the back plate (200) and the silicon electrode (100) through a bushing fastening screw (300) in a state in which the silicon electrode (100) is positioned and placed on the back plate (200) in step (2),

20 wherein in step (1), the plurality of bushings (110) are fastened and fixed to the plurality of bushing tabs formed on the silicon electrode (100) to fasten the silicon electrode (100) used in the semiconductor etching process equipment, the plurality of bushings (110) are made of Torlon or engineering
25 plastic, and

each of the bushings (110) is fastened to each of the bushing tabs of the silicon electrode (100) used in the semiconductor etching process equipment and is fastened to the silicon electrode (100) by applying a bonding agent free of
5 contamination and having strong adhesive force on an outer diameter surface thereof on which a screw thread is formed.

2. The method of claim 1, wherein the silicon electrode (100) is a 12-inch silicon electrode used in the semiconductor
10 etching process equipment, and is composed of one set of an inner silicon electrode (120) to which the bushings (110) for fastening to the back plate (200) are fastened and fixed and an outer silicon electrode (130).

15 3. The method of claim 2, wherein the silicon electrode (100) is composed of one set of the inner silicon electrode (120) to which the bushings (110) for fastening to the back plate (200) of the semiconductor etching process equipment are fastened and fixed and the outer silicon electrode (130), and a
20 screw thread for screwing with a bushing (110) is formed by machining an inner diameter of each of the bushing tabs for fastening and fixing the bushings (110).

4. The method of claim 2, wherein each of the bushings
25 (110) is fastened to each of the bushing tabs of the silicon

electrode (100) used in the semiconductor etching process equipment, and has a screw thread on an outer diameter surface thereof and a bushing tab on an inner diameter surface thereof so that the bushing (110) is inserted and fastened to the
5 bushing tab of the silicon electrode (100).