

Title

DEPOSITION CHAMBER AND METHOD OF USING THE SAME

Background of the Invention

1. Field of the Invention

The present invention is related to a deposition chamber and a method of using the same, and more particularly, to a deposition chamber with a sensor to *in-line and/or off-line* monitor the leveling of the heater and the method of using the same.

2. Description of the Prior Art

In recent years, as various kinds of consumer electronic products have been constantly developed towards miniaturization and the size of semiconductor components has reduced accordingly in order to meet requirements of high integration, high performance, low power consumption, and demands for the products.

The deposition of material on a wafer in the manufacture of integrated circuits is well known. In particular, chemical vapor deposition (CVD) is used to deposit various kinds of material layers on semiconductor wafers, for example, silicon dioxide (SiO₂), silicon nitride (SiN), poly-silicon, or other materials. CVD systems are typically automated systems that employ a plurality of processing chambers. Known CVD systems typically comprise a first air lock loading chamber in which cassettes containing a plurality of wafers to be processed are placed and from which the wafers are transported to a second vacuum chamber (or transportation chamber) by any suitable conveyor. Subsequently, the wafers are placed on a rotating table or stage in the deposition chamber. The deposition chamber then supplies an appropriate voltage and provides a high temperature required for the deposition process. Thereafter, the processed wafers are again transported back through the transportation chamber, to the loading chamber, and then back into the cassette for further handling/processing.

However, some problems may affect the quality of the deposition process, such as a dirty shower head, heater surface decline or heater leveling shifting.

A lot of studies have been made to understand and correct this problem, so as to improve the quality of the deposition process.

Summary of the Invention

The present invention therefore provides a deposition chamber with a sensor to *in-line and/or off-line* monitor the leveling of the heater to alleviate the problem of heater titling.

In one embodiment of the present invention, a deposition chamber is provided. The deposition chamber includes a heater base and at least a sensor. The heater base includes a heater plate and a heater lifter, wherein the heater lifter supports the heater plate, and the heater plate and a part of the heater lifter are enclosed in a chamber body. The sensor is disposed on the heater lifter to monitor the leveling of the heater.

In another embodiment, a method of monitoring the leveling of the heater in a deposition chamber is provided. A deposition chamber as described above is provided. The sensor is used to detect a distance between the sensor and a bottom surface of the chamber body. Then, the leveling of the heater is calibrated according to the distance.

In the present invention, the sensor is fixed on the heater lifter by a bracket to *in-line and/or off-line* detect the distance between the sensor and the chamber body. Once the sensor is utilized, the tilt problem of the heater can be alleviated and the quality of formed film on the wafer during the deposition process can be upgraded.

These and other objectives of the present invention will no doubt become obvious to those of ordinary skill in the art after reading the following detailed description of the preferred embodiment that is illustrated in the various figures and drawings.

Brief Description of the Drawings

FIG. 1 illustrates a schematic diagram of the deposition chamber

according to one embodiment of the present invention.

FIG. 2 shows a schematic diagram of the unwanted leveling of the heater during a deposition process.

FIG. 3 and FIG. 4 show schematic diagrams of the leveling screws and the leveling nuts in the deposition chamber of the present invention

FIG. 5 illustrates a schematic diagram of the bracket in the present invention.

FIG. 6 shows a flow chart of the method of *in-line* and/or *off-line* monitoring the leveling of the heater in a deposition chamber in the present invention.

Detailed Description

To provide a better understanding of the presented invention, preferred embodiments will be detailed. The preferred embodiments of the present invention are illustrated in the accompanying drawings with numbered elements.

Please refer to FIG. 1, which illustrates a schematic diagram of the deposition chamber according to one embodiment of the present invention. As shown in FIG. 1, the deposition chamber 300 in the present invention includes a chamber body 302, a heater base 316, a gas inlet 301 and a gas outlet 303. The chamber body 302 includes a bottom surface 306 and a sidewall 304, wherein the sidewall 304 may include a wafer port (not shown) for receiving a wafer 310 in the deposition chamber 300. Once introduced into the deposition chamber 300, the wafer 310 is placed on the heater base 316 and is then subjected to a deposition process by providing at least one material gas, in a condition with an appropriate voltage and a processing temperature. The material gas, which is the source of the material film ready to be formed on the wafer 310, is supplied by the gas inlet 301. Reacted or un-reacted material gas is then flowed out of the deposition chamber 300 through the gas outlet 303. The processing voltage or bias is provided by the heater base 316 which may be connected to a power supply (not shown) to give appropriate voltage for the deposition process. The processing temperature is maintained by the heater base 316. In one embodiment, the heater base 316 is composed of a heater plate 312 which is the main portion to support the wafer 310 and to send out

the heat energy in the deposition chamber 300, and a heater lifter 314 to support the heater plate 312. In one embodiment, the heater plate 312 and a part of the heater lifter 314 are enclosed in the chamber body 302, while the other part of the heater lifter 314 stretches downwardly from the bottom surface 306 of the chamber body 302.

As shown in FIG. 1, it is one salient feature in the present invention that at least a sensor 320 is fixed on the heater lifter 314 by a bracket 318 so as to *in-line* and/or *off-line* monitor the leveling of the heater base 316 during the deposition process. Please refer to FIG. 2, which shows a schematic diagram of the unwanted tilting of the heater base during a deposition process. In some circumstances, as shown in FIG. 2, the heater base 316 may be tilted due to a lot of reasons. If the heater base 316 is tilted during the deposition process, the above wafer 310 will be tilted as well, which may affect the thickness uniformity of the material film. As a result, in order to alleviate this problem, the present invention provides the sensor 320 being installed outside the heater lifter 314 so as to *in-situ* monitor the heater base 316 leveling during the deposition process. The sensor 320 can further monitor the tilt of the heater base *in-line* and/or *off-line* when the deposition process is not currently performed (that is, being idle), thus the sensor 320 can monitor within wafer variation, within batch variation and also batch-to-batch variation. Preferably, the sensor 320 is installed on the heater lifter 314 outside the chamber body 302 such that the sensor 320 would not be seriously affected by the high temperature (700 °C for example) during the deposition process in the chamber body 302. In one embodiment, the sensor 320 detects the distance P between the bottom surface 306 and the sensor 320. The sensor 320, for example, can emit a signal which can be reflected at the bottom surface 306 and detected by the sensor 320. Thus, the distance P can be detected and calculated by the sensor 320 or the computer (not shown) connected to the sensor 320. In one embodiment, as shown in FIG. 2, two sensors 320 are used to detect the distance P1 and distance P2, respectively. Once the distance P1 and the distance P2 are not equal or their difference is higher than a specific value, the computer (not shown) will regard the heater base 316 being tilted and further inform the operator to fix the problem. In another embodiment, only one sensor

320 can also achieve the approach by comparing the detected distance P with a predetermined value.

Please refer to FIG. 3 and FIG. 4, which show schematic diagrams of the leveling screws and the leveling nuts in the deposition chamber of the present invention, wherein FIG. 3 represents a side view and FIG. 4 represents a bottom view. As shown in FIG. 3, the present invention further provides at least one set of leveling screw 322 and leveling nut 324 for fixing the tilting of the heater base 316. In one embodiment, the leveling screws 322 and leveling nuts 324 are disposed right under the bottom surface 306 of the chamber body 302. The leveling nuts 324 are fixed onto the heater lifter 314 while the leveling screws 322 are lodged into the bottom surface 306 through the leveling nuts 324. If the heater base 316 is regarded as being tilted, for example, with right side up and left side down as shown in FIG. 2, the operator can fix the tilt problem by rotating the leveling screws 322 to adjust the relative distances such that each distance between each leveling screwing 322 and the bottom surface 306 is equal to each other, or alternatively, their difference is less than a specific value. As shown in FIG. 4, three leveling screws 322 are positioned in a same distance therefrom to the heater lifter 314, thereby forming a substantially regular triangle shape. In one embodiment, only two leveling screws 322 are required to be adjusted to compensate the tilt of the heater base 316. However, in some embodiment, more than three sets of leveling screws 322 and leveling nuts 324 can be used.

Please refer to FIG. 5, which illustrates a schematic diagram of the bracket in the present invention. As shown in FIG. 5, the bracket 318 has an L-shaped wherein the sensor 320 is disposed on top of the L-shaped bracket 318. In detail, the bracket 318 is composed of three components, including the first unit 318a, the second unit 318b and the third unit 318c. In one embodiment, a first joint portion A is located between the first unit 318a and the second unit 318b, thereby providing the sensor 320 being adjusted along the x-axis. A second joint portion B is located between the second unit 318b and the third unit 318c, thereby providing the sensor 320 being adjusted along the y-axis. Thus, the position of the sensor 320 can be adjusted according to different

situations.

Please refer to FIG. 6, which shows a flow chart of the method of *in-line* and/or *off-line* monitoring the leveling of the heater base in a deposition chamber in the present invention. As shown in FIG. 6, a deposition chamber is provided (step 400). In one embodiment, the deposition chamber is similar to the embodiment as shown in FIG. 1. Preferably, the deposition chamber has a heater lifter with at least one sensor installed thereon. Then, a distance between the sensor and a bottom surface of the chamber is detected (step 402). Once the heater is regarded as being tilted, the leveling of the heater can be adjusted according to the detected distance (step 404). In one embodiment, the adjustment of the heater can be achieved by adjusting the leveling screws, as shown in FIG. 3 and FIG. 4.

In light of above, the present invention provides a deposition chamber and a method of using the deposition chamber to *in-line* and/or *off-line* monitor heater tilting in the deposition chamber. The sensor is fixed on the heater lifter by a bracket to detect the distance between the sensor and the chamber body. Once the sensor is utilized, the tilt problem of the heater base can be alleviated and the quality of formed film on the wafer during the deposition process can be upgraded.

Those skilled in the art will readily observe that numerous modifications and alterations of the device and method may be made while retaining the teachings of the invention. Accordingly, the above disclosure should be construed as limited only by the metes and bounds of the appended claims.

Claims

What is claimed is:

1. A deposition chamber, comprising:
a heater base for supporting a wafer, wherein the heater base comprises a heater plate and a heater lifter, wherein the heater lifter supports the heater plate, and the heater plate and a part of the heater lifter are enclosed in a chamber body; and
at least a sensor attached to the heater lifter to monitor the leveling of the heater.
2. According to the deposition chamber as shown in claim 1, wherein the sensor is disposed outside the chamber body.
3. According to the deposition chamber as shown in claim 1, wherein the sensor is installed on the heater lifter by an-L-shaped bracket.
4. According to the deposition chamber as shown in claim 3, wherein the L-shaped bracket is composed of three units.
5. According to the deposition chamber as shown in claim 4, wherein a joint is located between each two units of the L-shaped bracket.
6. According to the deposition chamber as shown in claim 1, wherein the sensor is used to detect a distance between the sensor and a bottom surface of the chamber body.
7. According to the deposition chamber as shown in claim 1, wherein two sensors are installed on the heater lifter.
8. According to the deposition chamber as shown in claim 1, further comprising a plurality of sets of leveling screw and leveling nut disposed on the

heater lifter to calibrate the leveling of the heater base.

9. According to the deposition chamber as shown in claim 8, wherein three sets of leveling screw and leveling nut are provided to form a regular triangle shape.

10. A method of monitoring the leveling of the heater base in a deposition chamber, comprising:

providing a deposition chamber as shown in claim 1;

using the sensor to detect a distance between the sensor and a bottom surface of the chamber body; and

calibrating the leveling of the heater according to the distance.

11. According to the method of monitoring the leveling of the heater base in a deposition chamber in claim 10, the sensor *in-line* and/or *off-line* detects the distance during a deposition process.

12. According to the method of monitoring the leveling of the heater base in a deposition chamber in claim 10, wherein the sensor detects the distance when a deposition process is performed in the deposition chamber.

13. According to the method of monitoring the leveling of the heater base in a deposition chamber in claim 10, wherein the sensor detects the distance when a deposition process is not performed in the deposition chamber.

14. According to the method of monitoring the leveling of the heater base in a deposition chamber in claim 10, the calibration step adjusts a plurality of sets of leveling screws on the heater.

15. According to the method of monitoring the leveling of the heater base in a deposition chamber in claim 14, three sets of leveling screw and leveling nut are provided to form a regular triangle shape, wherein only two sets of leveling screw and leveling nut are required to calibrate the leveling of the heater.