Heat Reflecting Device and Semiconductor Processing Apparatus

Field of the Invention

The present invention relates to the semiconductor processing field, in particularly, relates to a heat reflecting device and a semiconductor processing apparatus using the same.

Background of the Invention

Recently, with the development of technology, Chemical Vapor Deposition (CVD for short) technology has been used more and more frequently. Especially, the Metal Organic Chemical Vapor Deposition (MOCVD for short) technology gradually becomes the main coating technology in the industry, since it has advantages of the easy- controllable coating film composition, the uniform and dense coating film, and good adhesion, etc. So-called MOCVD technology refers to a kind of Chemical Vapor Deposition technology using Metal Organic (MO for short) as source material. The principle of the MOCVD technology is as follows: the film is grown in gas phase by thermal decomposition reaction of organo-metallic material gas, hydride gas, or halogenated gas. In a practical process, the apparatus where CVD takes place is called a CVD apparatus; the apparatus where CVD using MO gas takes place is called a MOCVD apparatus.

Typically, a tray device for carrying substrates to be processed is provided in the process chamber of the MOCVD apparatus, and outside the process chamber an induction heater is provided to heat the process chamber to a temperature required. In the practical process, part of the heat generated by the induction heater is transferred into the process chamber, and at the same time, the rest of the heat gets lost around the induction heater.

Summary of the Invention

The present invention provides a heat reflecting device, which can prevent heat loss by reflecting heat towards the process chamber during a temperature-rising or temperature-maintaining period for the process chamber.

The present invention also provides a semiconductor processing

apparatus comprising the above-mentioned heat reflecting device, which can prevent heat loss by reflecting heat towards the process chamber during a temperature-rising or temperature-maintaining period for the process chamber as well.

To this end, the present invention provides a heat reflecting device for a semiconductor processing apparatus which comprises a process chamber, the heat reflecting device comprises at least one heat reflecting unit, each of which has a reflecting surface being able to reflect heat. The heat reflecting device is provided in the periphery of the process chamber to reflect heat towards the process chamber.

Wherein, the heat reflecting device according to the present invention further comprises a position shifting unit which is connected with the heat reflecting unit to drive the heat reflecting unit to move, so that during the temperature-rising or temperature-maintaining period for the process chamber, the reflecting surface of the reflecting unit can be made to face towards the process chamber to reflect heat to it; and during the temperature-falling period for the process chamber, the reflecting surface of the reflecting unit can be made to be deviated from the process chamber to facilitate heat dissipation of the process chamber.

Wherein, the position shifting unit comprises an elevating device which makes the reflecting surface of the heat reflecting unit face towards or deviate from the process chamber by driving the heat reflecting unit to move vertically.

Wherein, the number of the heat reflecting units is at least two, and the position shifting unit comprises a rotating device which drives the heat reflecting device to rotate an angle so that the reflecting surfaces of the heat reflecting units may face towards or deviate from the process chamber.

Wherein, the number of the heat reflecting units is 2n, and n pivot shafts for receiving the heat reflecting units are provided in the rotating device, wherein n is an integer not less than 1; for each pivot shaft, two reflecting units closely adjacent to said pivot shaft at both sides are both provided thereon and can rotate around it so that the reflecting surfaces of the heat reflecting units face towards or deviate from the process chamber according to process requirements.

Wherein, the number of the heat reflecting units is m, and m pivot shafts for receiving the heat reflecting units are provided in the rotating device, wherein m is an integer not less than 2; the m heat reflecting units correspond to the m pivot shafts one to one, each heat reflecting unit is fixed to a corresponding pivot shaft to rotate with it, or each heat reflecting unit is provided to a corresponding pivot shaft to rotate around it so that the reflecting surface of the heating reflecting unit faces towards or deviates from the process chamber.

Wherein, during a temperature-rising or temperature-maintaining period for the process chamber, the reflecting surface of the heat reflecting unit extends along the direction of the tangent line to the process chamber; during a temperature-falling period for the process chamber, the reflecting surface of the heating reflecting unit extends along the direction of the normal line to the process chamber.

Wherein, the rotating device comprises a rotation-driving source, each heat reflecting unit is connected to the rotation-driving source and is driven by the rotation-driving source to rotate.

Wherein, in the rotating device, corresponding to each heat reflecting unit, a rotation delivering part, which is connected between the rotation-driving source and the heat reflecting unit, and deliver rotation driving force from the rotation-driving source to the heat reflecting unit, is provided.

Wherein, there is one rotation driving source provided, each rotation delivering part is connected to the one rotation-driving source to deliver the rotation driving force from the rotation driving source to each heat reflecting unit.

Wherein, tolerance temperature of the heat reflecting unit is 1500 ℃, and each heat reflecting unit comprises k heat-radiation reflecting mirrors which are arranged with certain intervals, wherein, k is an integer not less than 2.

Wherein, the heat-radiation reflecting mirror is made of copper plate, aluminum plate, steel plate or silver plate.

Wherein, the heat-radiation reflecting mirror consists of a base and a reflecting film on the surface of the base.

Wherein, the base of the heat-radiation reflecting mirror comprises a

copper plate, an aluminum plate, a steel plate or a silver plate, and the reflecting film is metal plating or metal coating.

Moreover, the present invention also provides a semiconductor processing apparatus comprising a process chamber, and the above mentioned heat reflecting device is disposed in the periphery of the process chamber for reflecting heat towards the process chamber.

Wherein, an induction heater is provided outside the process chamber to heat it, the heat reflecting device is provided in the periphery of the induction heater to reflect heat towards the process chamber.

Wherein, a tray device for carrying substrates to be processed is provided in the process chamber.

Wherein, the semiconductor processing apparatus includes a crystallized film growth apparatus, the tray device comprises a plurality of trays stacked together, and there is a distance between two adjacent trays.

Wherein, the plurality of trays are stacked together longitudinally along the height direction of the process chamber.

As the heat reflecting device provided by the present invention may be deposed in the periphery of the process chamber and has a reflecting surface capable of reflecting heat, so by means of the heat reflecting device, radiation heat can be reflected towards the process chamber.

In a preferable embodiment of the present invention, a position shifting unit which can drive the heat reflecting unit to move is also provided in the heat reflecting device. As a result, during the temperature-rising or temperature-maintaining period for the process chamber, the reflecting surface of the heat reflecting unit is made to face towards the process chamber and/or the induction heater to reflect the radiation heat towards the process chamber, and during the temperature-falling period for the process chamber, the reflecting surface of the heat reflecting unit is made to deviate from the process chamber and/or the induction heater to facilitate heat dissipation.

Brief Description of the Drawings

Fig.1 is a top view of the heat reflecting device according to one

embodiment of the present invention;

Fig. 2a is a schematic structural view of the heat reflecting unit used in the heat reflecting device shown in Fig. 1;

Fig. 2b is a top view of the heat reflecting unit shown in Fig. 2a;

Fig. 3 is a cross-sectional view of a basic structure of a semiconductor processing apparatus provided with the heat reflecting device in Fig. 1 according to one embodiment of the present invention;

Fig. 4 is a top view of the semiconductor processing apparatus in Fig. 3 without the filtering chamber.

Detailed Description of the Preferred Embodiments

The core technology of the present invention is to provide a heat reflecting device which may be applied in a semiconductor processing apparatus with a process chamber. The heat reflecting device comprises at least one heat reflecting unit, each of which has a reflecting surface capable of reflecting heat, and the heat reflecting device is disposed in the periphery of the process chamber to reflect heat towards the process chamber. Preferably, a detailed embodiment of the present invention further provides a heat reflecting device provided with a position shifting unit, wherein, the position shifting unit is connected with the heat reflecting unit to drive the heat reflecting unit to move, so as to adjust heat reflected towards the process chamber. Specifically, during the temperature-rising or temperature-maintaining period for the process chamber, the reflecting surface of the heat reflecting unit can be made to face towards the process chamber to reflect heat to the same; and during the temperature-falling period for the process chamber, the reflecting surface of the reflecting unit can be made to deviate from the process chamber to facilitate heat dissipation of the process chamber.

Fig.1 is the top view of the heat reflecting device according to one embodiment of the present invention; Fig. 2a is the schematic structural view of the heat reflecting unit used in the heat reflecting device shown in Fig.1; and Fig. 2b is the top view of the heat reflecting unit illustrated in Fig.2a. Referring to Fig.1, Fig.2a and Fig.2b together, the heat reflecting device 600 provided by the present embodiment comprises 13 heat reflecting units 604 and position

shifting units, each of which comprises a pivot shaft 601, connected with the heat reflecting units 604.

In the present embodiment, each heat reflecting unit 604 includes 4 heat-radiation reflecting mirrors 602, two adjacent ones of which are separated by a certain distance, provided on corresponding pivot shaft 601 in turn, and each heat-radiation reflecting mirror 602 has at least one reflecting surface capable of reflecting heat.

Wherein, the main body and the reflecting surface of the heat-radiation reflecting mirror 602 can be made of metal material with heat-radiation reflecting characteristics such as copper plate, aluminum plate, steel plate or silver plate etc., and the main body and the reflecting surface of the heat-radiation reflecting mirror 602 can be integrated. Of course, in a practical application, the heat-radiation reflecting mirror 602 can be made as follows, that is, preparing a base by using the material that can withstand the temperature required during the semiconductor processing process, and providing metal coating or metal plating with the heat-radiation reflecting characteristics which can also meet the temperature required during the semiconductor processing process, to form the reflecting surface of the heat-radiation reflecting mirror 602. Wherein, the base can be made of copper plate, aluminum plate, steel plate or other material which can withstand the temperature required during the semiconductor processing process; and the metal plating or coating can be made of metal such as gold, or silver, etc. or other metallic compound with the heat-radiation reflecting characteristics. As the main body of the heat-radiation reflecting mirror or the reflecting surface thereon is made of metal material, so in order to avoid induced current flowing therethrough, it is required to provide a plurality of discontinuous heat-radiation reflecting mirrors in one heat reflecting unit, that is, there is a distance between two adjacent heat-radiation reflecting mirrors, as shown in Fig. 2a.

What should be pointed out is that, in practical process, the tolerance temperature of the heat reflecting device 600 and the material used therefor should be chosen according to the specific semiconductor process. For example, for the crystallized film growth process, the process temperature ranges from 500℃ to 1400℃, so the tolerance temperature of the heat

reflecting device should be 1400℃ or more, for example, may be 1400℃, 1450℃ or 1500℃.

In the present embodiment, the position shifting unit is a rotating device for driving the heat reflecting unit 604 to rotate by an angle so that the reflecting surface of the heat reflecting unit 604 can face towards or deviate from the process chamber. As shown in the figures, a rotating device mainly comprises: a pivot shaft 601 for fixing the heat reflecting unit 604 and driving the heat reflecting unit 604 to rotate; a rotation-driving source 610 for providing rotation-driving force for the heat reflecting unit 604; a rotation delivering part 603 which is connected between the pivot shaft 601 and the rotation-driving source 610 for delivering the rotation driving force from the rotation-driving source 610 to the pivot shaft 601; and a joint rotation association part 605 which connects the rotation delivering parts 603 of the respective heat reflecting units 604 together, to facilitate joint rotation of the respective heat reflecting units 604.

Specifically, the joint rotation of the respective heat reflecting units 604 can be achieved as follows, i.e. coupling one end of the rotation delivering part 603 of each heat reflecting unit 604 to the respective pivot shaft 601, and coupling the other end of each rotation delivering part 603 to the same rotation-driving source 610 via the joint rotation association part 605. Thus, as long as the rotation-driving source 610 applies the joint rotation association part 605 or any one of the rotation delivering parts 603 with force which makes it rotate clockwise or counterclockwise, the 13 rotation delivering parts 603 may be driven together to rotate clockwise or counterclockwise, so that the heat reflecting unit 604 connected thereto may be driven to rotate to shift the position thereof, so as to realize the joint rotation of the respective heat reflecting units 604.

The joint rotation association part 605 may be configured to be a rigid connection member such as a metal stick, a ceramic stick, etc., which is connected between the respective rotation delivering parts 603, and by means of which a rigid connection between the respective rotation delivering parts 603 may be achieved. Also, the joint rotation association part 605 may be a rope, preferably a rope without elasticity, which is connected to the respective

rotation delivering parts 603, and by means of which a flexible connection between the respective rotation delivering parts 603 may be achieved. When the above-mentioned flexible connection is used, each pivot shaft 601 should be provided with an elastic restoration member, such as a restoration spring, such that, when the rotation-driving source 610 no longer applies deviating force which makes the heat reflecting unit 604 deviate from its initial position, the pivot shafts 601 can drive the heat reflecting units 604 to rotate back to their initial positions by means of their elastic restoration member. Regarding the previous-mentioned rigid connection, it is not required to provide each pivot shaft 601 with the above elastic restoration member.

Also, in a practical application, it is also possible that the rotation delivering parts 603 of the respective heat reflecting units 604 are not connected together, but connected to the same one rotation-driving source 610 separately to deliver the driving force from the rotation-driving source 610 to each heat reflecting unit 604; alternatively, the rotation delivering parts 603 of the heat reflecting units 604 may be connected to different rotation-driving sources 610 respectively to deliver the driving force from the respective rotation-driving sources 610 to the corresponding heat reflecting units 604 respectively. It should be understood that, comparing with the embodiment shown in Fig. 1, such connection would make the structure more complex, thus increasing cost. Besides, it is difficult to guarantee cooperation among operations of the respective heat reflecting units 604, so the connection shown in the Fig. 1 is preferred in a practical application.

Besides, it should be noted that, in the rotating device used in the present embodiment, corresponding to each heat reflecting unit 604, a rotation delivering part 603 connected to the rotation-driving source 610 is provided, and by means of the rotation delivering part 603 the rotating driving force from the rotation-driving source 610 can be delivered to the heat reflecting unit 604. The rotation delivering part 603 may be provided on the pivot shaft 601 to deliver the rotation driving force from the rotation-driving source 610 to the pivot shaft 601 by which the heat reflecting unit 604 was driven to rotate to shift the position thereof. Also, the rotation delivering part 603 may be provided on the heat reflecting unit 604, so that the rotation driving force from the

rotation-driving source 610 can be delivered to the heat reflecting unit 604 by the rotation delivering part 603 to directly drive the heat reflecting unit 604 to rotate around or with the pivot shaft 601 and shift the orientation thereof.

It should be further noted that, although the number of the heat reflecting units is 13 in the foregoing embodiment, in a practical application, the number of the heat reflecting units is not limited thereto, and may be other numbers, for example, the number of the heat reflecting units may be only 1, or 2, or more than 2. Moreover, the number of the heat-radiation reflecting mirrors included in each heat reflecting unit is not limited to 4 described in the forgoing embodiment, but may be k, wherein, k is an integer not less than 2.

In a practical application, when the number of the heat reflecting unit is 1, the heat reflecting unit may be configured to be a cylinder. During a temperature-rising or temperature-maintaining period for the process chamber, the cylindrical heat reflecting unit is covered outside the process chamber to reflect heat towards the process chamber; and during the temperature-falling period for the process chamber, by means of a position shifting unit, such as an elevating device, the heat reflecting unit can move in the vertical direction (upwardly or downwardly), such that the heat reflecting unit can be away from the area of the process chamber to leave a heat dissipating channel for the process chamber.

When the number of the heat reflecting units is 2 or more, the position shifting unit may include a rotating device, by means of which the heat reflecting unit can be driven to rotate by an angle, so that the reflecting surface of the heat reflecting unit can face towards or deviate from the process chamber according to the process requirements. Besides, the number of the pivot shafts in the position shifting unit may be equal to that of the heat reflecting units, for example, the number of the heat reflecting units is m, accordingly, the number of the pivot shafts in the rotating device for installing the heat reflecting units is m too, wherein, m is an integer not less than 2. The m heat reflecting units correspond to the m pivot shafts one to one, so that each heat reflecting unit is provided on a pivot shaft corresponding thereto and is rotatable around it, so as to make the reflecting surface of the heat reflecting unit face towards or deviate from the process chamber according to the

process requirements; alternatively, each heat reflecting unit is fixed on the corresponding pivot shaft and is rotatable with it, so as to make the reflecting surface of the heat reflecting unit face towards or deviate from the process chamber according to the process requirements.

Also, the number of the pivot shafts in the position shifting units may be unequal to that of the heat reflecting units, for example, the number of the heat reflecting units may be set to be 2n, and the number of the pivot shafts in the rotating devices for installing the heat reflecting units may be set to be n, wherein, n is an integer not less than 1. In this way, for each pivot shaft, two heat reflecting units closely adjacent to the pivot shaft at both sides are provided on the pivot shat and are rotatable with it, so as to make the reflecting surface of the heat reflecting unit face toward or deviate from the process chamber according to process requirements.

It should be understood that, the heat reflecting device provided by the present invention may not be provided with any position shifting unit, but the heat reflecting units may be fixed in the periphery of the process chamber, and the reflecting surfaces of the heat reflecting units may be made to face towards the process chamber all the time. Of course, by this way, in the temperature-falling period for the process chamber, temperature would drop slowly.

It's also to be noted that, during the temperature-rising or temperature-maintaining period for the process chamber, if the reflecting surfaces of the heat reflecting units are made to extend along the direction of the tangent line to the process chamber, i.e. the reflecting surfaces of the heat reflecting units are made to be perpendicular to the direction of the normal line to the process chamber, amount of heat reflected towards the process chamber by the heat reflecting unit would be maximum. During the temperature-falling period for the process chamber, if the reflecting surfaces of the heat reflecting units are made to extend along the direction of the normal line to the process chamber, amount of heat reflected towards the process chamber by the heat reflecting unit would be minimum, and in this way, the heat dissipating channel for the process chamber would be maximum, which is in most favor of fast dissipating heat for the process chamber.

Besides, although in the foregoing embodiment, the position shift of the heat reflecting units, i.e., the reflecting surfaces of the heat reflecting units facing towards or deviating from the process chamber, is achieved by means of rotating, in a practical application, an elevating device may be used to move in the vertical direction to drive the heat reflecting units to move upwardly or downwardly so as to make the heat reflecting unit face towards or deviate from the process chamber; or a turnover device may be used to drive the heat reflecting units to turn over by an angle so as to make the heat reflecting unit face towards or deviate from the process chamber. For example, during the temperature-rising or temperature-maintaining period for the process chamber, the heat reflecting units are made to face towards the induction heater and the process chamber; and during the temperature-falling period for the process chamber, each heat reflecting unit is lifted by the elevating device to be away from the process chamber, so as to leave a heat dissipating channel for the process chamber to dissipate heat. For another example, a turnover shaft is provided in the upper area or lower area outside the process chamber and the heat reflecting units are provided on the turnover shaft. By means of the turnover movement of the heat reflecting units around the turnover shaft, the reflecting surfaces of the heat reflecting units are driven to face towards the induction heater and the process chamber during the temperature-rising or temperature-maintaining period for the process chamber; and the reflecting surfaces of the heat reflecting units are driven to deviate from the process chamber to leave a heat dissipating channel for the process chamber to dissipate heat during the temperature-falling period for the process chamber. Of course, in a practical application, the position shifting unit is not necessarily limited to the forgoing embodiment, and actually, any construction that can make the heat reflecting unit face towards or deviate from the process chamber according to the process requirements can be used.

Fig. 3 is the cross-sectional view of a basic structure of a semiconductor processing apparatus provided with the heat reflecting device in Fig. 1 according to an embodiment of the present invention; Fig. 4 is the top view of the semiconductor processing apparatus in Fig. 3 without the filtering chamber. Thereinafter, the semiconductor processing apparatus provided with the heat

reflecting device according to the present invention will be described in detail referring to Fig. 3 and Fig. 4 together.

As shown in Fig.3 and Fig. 4, the semiconductor processing apparatus provided in this embodiment comprises: a semiconductor processing device 300 and the above-mentioned heat reflecting device 600 according to this invention.

Wherein, the semiconductor processing device 300 comprises an outer chamber wall 321 for cutting off atmosphere, an inner chamber wall 317 and a process chamber 301 surrounded by the inner chamber wall 317. In this embodiment, the inner chamber wall 317, the surface of which is covered by SiC, is made of graphite, in a practical application, the inner chamber wall 317 may be made of quartz.

A tray device for carrying substrates 302 to be processed is provided inside the process chamber 301. The tray device comprises 11 trays provided longitudinally (i.e., along the height direction of the process chamber 301) from top to bottom in turn. Every tray is shaped to be an annulus, wherein the entity portion of the annulus is used to carry workpieces to be processed, such as substrates, and the hollow portion is surrounded by the entity portion. Every tray, the surface of which is covered by SiC, is made of graphite, and there is a distance, for example 0.5 cm~8 cm, preferably 1 cm~3 cm, between two adjacent trays.

A process gas conveying system 310 running through the whole tray device from top to bottom, which may be made of quartz, is provided in the process chamber. The process gas conveying system 310 is provided with process gas exits 311 which correspond to upper surfaces of the 9 trays in the middle of the tray device, to introduce the process gas from the process gas conveying system 310 onto the surface of each tray. A main process gas conduit 313 for introducing process gas from outside into the process gas conveying system 310 is provided in the process gas conveying system 310. As the main process gas conduit 313 is relatively long, the amount of gas discharged from the process gas exits 311 in the upper part is larger than the amount of gas discharged from the process gas exits 311 in the lower part. Thus, a process gas compensating conduit 314 is required to compensate for

conveying ability of the main process gas conduit 313. Thus, as the process gas compensating conduit 314 is provided, amount of process gas introduced onto surfaces of different trays can be controlled to make the amount of process gas on the surfaces of the respective trays to be generally equal. Of course, in a practical application, the numbers of the main process gas conduit 313 and the process gas compensating conduit 314 are not necessarily limited to the above-mentioned number, but could be increased or decreased according to the process requirements.

An induction heating coil 304 is provided surrounding the outer chamber wall 321 to heat the tray device in the process chamber 301 by means of induction heating, so that the substrates 302 carried by the tray device can be at the temperature required by the process. Generally, in the tray device, as the heat of the tray in the lowest layer and the tray in the topmost layer is easy to be lost, parts of the induction heating coil 304 at both ends are arranged to be denser to supply more heat to the tray in the lowest layer and the tray in the topmost layer. Of course, in a practical application, the induction heating coil 304 should be arranged according to the process requirements and is not limited to that described in the present embodiment.

As shown in Fig. 3, in order to further ensure that the substrates 302 are in an uniform temperature field and airflow field, the substrates 302 can be disposed on the upper surfaces of the 9 trays between the tray in the lowest layer and the tray in the topmost layer, the tray in the lowest layer and the tray in the topmost layer function as two foil trays and no substrate is disposed thereon, so that, by means of the two foil trays, the heat dissipation of the whole tray device can be prevented, then temperature can be maintained for 9 trays in the middle to ensure that the 9 trays and substrates 302 carried thereon are in an uniform temperature field. Actually, when there are four or more trays in the tray device, the tray in the lowest layer and the tray in the topmost layer can be specially used as foil trays with no substrate carried thereon, and are used to maintain temperature.

Besides, in the semiconductor processing apparatus 300 according to the embodiment, a filtering chamber 318 is disposed above the process chamber 301, a chamber gas vent 322 is provided on the upper part of the filtering

chamber 318 at an approximate central position, and purge gas and the unreacted process gas are discharged from the chamber gas vent 322. The filtering chamber 318 is composed of several layers of filtering substrates 324 on each of which several through holes 319 are provided. Thus, the unreacted process gas in the process chamber 301 may flow through the through holes 319 on the lowest layer of the filtering substrate 324 into the filtering chamber 318, diffuse therein and then crystal grow on the filtering substrate so that the unreacted process gas is consumed. As the unreacted process gas may grow to a crystallized film which is difficult to fall off, rather than particles easy to fall off, contamination caused by particles may be decreased by means of the filtering chamber 318.

In the present embodiment, outside the semiconductor processing device 300, the heat reflecting device 600 according to the present invention is provided. Specifically, the heat reflecting device 600 surrounds the periphery of the induction heater 304. Each heat reflecting unit 604 in the heat reflecting device 600 is rotated by means of the rotation-driving source 610 to change the position relationship of the heat reflecting units 604 relative to the process chamber 301 and/or the induction heater 304, for example, the heat reflecting units 604 is driven to rotate by the rotation driving source 601 so that during the temperature-rising or temperature-maintaining period for the process chamber 301, the reflection surfaces of the heat reflecting units 604 may face towards the process chamber 301, thus heat emitted from the induction heater 304 and/or from inside of the process chamber 301 is reflected towards the process chamber 301 when arriving at the heat reflecting device 600; during the heat dissipating period of the process chamber 301, the reflection surface of the heat reflecting units 604 may deviate from the process chamber to leave a heat dissipating channel for the process chamber 301 to dissipate heat.

In the semiconductor processing apparatus according to the present embodiment, as the heat reflecting device 600 according to the present invention is provided in the periphery of the induction heater 304, and the reflection surfaces of the heat reflecting units 604 in the heat reflecting device 600 may face towards or deviate from the process chamber 301 according to

the process requirements, therefore the semiconductor processing apparatus according to the present invention can not only make temperature in the process chamber 301 rise rapidly during the temperature-rising period for the process chamber 301 and make temperature in the process chamber 301 maintain to be substantially constant during the temperature-maintaining period for the process chamber, but also make the process chamber dissipate heat rapidly during the heat dissipating period for the process chamber 301.

It should be understood that, although the heat reflecting device in the forgoing embodiment is provided to be around the whole induction heater, in a practical application, the heat reflecting device can be only provided on part of the induction heater, and despite that such a manner will not achieve the effect of preventing heat dissipation as good as that of the forgoing embodiment, the problem of heat loss may be solved at a certain degree. Besides, although the heat reflection device according to the forgoing embodiment comprises a plurality of heat reflecting units, in a practical application, the heat reflection device may comprise only one heat reflecting unit with the shape of cylinder to surround the induction heater therein, and in order to ensure that the position of the heat reflecting unit can shift, a position shifting unit such as an elevating device may be provided correspondingly.

It should also be understood that, the heat reflecting device according to the present invention may be used in a semiconductor processing apparatus which uses an induction heater to heat; the heat reflecting device according to the present invention may also be used in a semiconductor processing apparatus which only needs temperature-maintaining without being heated (i.e., no induction heater is provided in the semiconductor processing apparatus), in this case, the heat reflecting device may be disposed in the periphery of the process chamber directly, so that the radiation heat radiated from the process chamber can be reflected towards the process chamber to achieve the temperature maintenance of the process chamber.

How the heat reflecting device controls the temperature inside the process chamber in a crystallized film growth process will be described by the following example, wherein, 16 substrates are carried on each tray.

Firstly, the induction heater 304 is used to heat the process chamber 301,

10SLM hydrogen is introduced via the purge gas inlet 320, and 20SLM hydrogen is introduced into the process chamber 301 through the main process gas conduit 313 and the process gas compensating conduit 314 respectively. The temperature reaches 1000℃ by heating, and keeps for 5 minutes to clean the surface of the substrates 302.

Then, based on a signal from the rotation driving source 610, the pivot shafts 601 are rotated to drive the heat-radiation reflecting mirrors 602 to move, until the reflection surfaces of the heat-radiation reflecting mirrors 602 extend along the direction of the normal line to the process chamber 301 (i.e. , the direction perpendicular to the process chamber 301), so that the reflecting surfaces of the heat reflecting units 604 may deviate from the area of the process chamber 301 to leave a heat dissipating channel for the process chamber, which makes temperature of the process chamber 301 fall fast.

And then, when temperature inside the process chamber 301 falls to 500℃, ammonia gas at a flow rate of 10SLM is introduced through the main process gas conduit 313 and the process gas compensating conduit 314 respectively. TMG is bubbled by 300SCCM hydrogen, and introduced into the process chamber 301 through the main process gas conduit 313 and the process gas compensating conduit 314 for 3 minutes. An amorphous layer is formed in this procedure.

TMG stops to be introduced, the heat-radiation reflecting mirrors are again made to rotate, and the reflecting surfaces of the heat-radiation reflecting mirrors are made to face towards the process chamber 301. Thus, the heat radiated from the process chamber 301 may be reflected towards the process chamber 301 efficiently, so that the temperature inside the process chamber can rapidly rise to a first predetermined temperature required by the process, such as 1100℃,.

Then, ammonia gas at a flow rate of 25SLM is introduced into the process chamber 301 through the main process gas conduit 313 and the process gas compensating conduit 314 respectively, and nitrogen gas at a flow rate of 5SLM is introduced into the process chamber 301. In this procedure, TMG is bubbled by 200SCCM hydrogen, and introduced into the process chamber 301 through the main process gas conduit 313 and the process gas compensating

conduit 314.

After the GaN film growing for 1 hour, the process gas stops to be introduced, and the heat-radiation reflecting mirrors 602 are again made to rotate to change the orientation thereof so that the reflecting surfaces thereof may deviate from the process chamber 301 to leave a heat dissipating channel for the process chamber 301 to dissipate heat, and cool the process chamber to a second predetermined temperature, such as 750℃.

Then, TMG and TMIn are introduced into the process chamber 301, to make an InGaN film grown on the GaN film.

Then, hydrogen stops to be introduced, nitrogen is used to make the process chamber 301 restore to a room temperature and the atmospheric pressure, and the substrates 302 are recycled and detected. After detection, it's found that, when measuring thickness of the 64 substrates 302 on the 4 trays, the fluctuation range of the thickness of the crystallized film on the substrates 302 is within ±3%; and when measuring thickness of the 80 substrates 302 on the 5 trays, the fluctuation range of the thickness of the crystallized film on the substrate 302 is within ±6%.

It can be seen that, in the semiconductor processing apparatus according to the present embodiment, the above-mentioned heat reflecting device according to the present invention is provided in the periphery of the process chamber, so that by means of the heat reflecting device, during the temperature-rising or temperature-maintaining period for the process chamber, radiation heat can be reflected towards the process chamber. During the temperature-falling period for the process chamber, the reflecting surfaces of the heat reflecting units can be made to deviate from the process chamber to facilitate heat dissipation of the process chamber.

It should be understood that, the above embodiments are only exemplary embodiments used to illustrate the principle of present invention, and the present invention is not limited thereto. Without departing from spirit and substance of the present invention, persons skilled in the art can make various modifications and improvements, which should be regarded as within the protection scope of the present invention.

WHAT IS CLAIMED IS:

1. A heat reflecting device for a semiconductor processing apparatus comprising a process chamber, wherein the heat reflecting device comprises at least one heat reflecting unit, each of which has a reflecting surface capable of reflecting heat, and the heat reflecting device is disposed in the periphery of the process chamber;

the heat reflecting device further comprising a position shifting unit which is connected with the at least one heat reflecting unit to drive the heat reflecting unit to move, so that during the temperature-rising or temperature-maintaining period for the process chamber, the reflecting surface of the at least one heat reflecting unit can be made to face towards the process chamber to reflect heat to it; and during the temperature-falling period for the process chamber, the reflecting surface of the at least one heat reflecting unit can be made to deviate from the process chamber for facilitating heat dissipation of the process chamber.

2. The heat reflecting device of claim 1, wherein the position shifting unit comprises an elevating device which makes the reflecting surface of the at least one heat reflecting unit face towards or deviate from the process chamber by driving the heat reflecting unit to move vertically.

3. The heat reflecting device of claim 1, wherein the number of the at least one heat reflecting unit is at least two, and the position shifting unit comprises a rotating device for driving the heat reflecting device to rotate by an angle so that the reflecting surfaces of the heat reflecting units face towards or deviate from the process chamber.

4. The heat reflecting device of claim 3, wherein the number of the heat reflecting units is at least 2n, and n pivot shafts for installing the heat reflecting units are provided in the rotating device, wherein n is an integer not less than 1;

for each pivot shaft, two heat reflecting units closely adjacent to the pivot

shaft at both sides are provided on the pivot shaft and can rotate around it, so that the reflecting surfaces of the heat reflecting units face towards or deviate from the process chamber according to process requirements.

5. The heat reflecting device of claim 3, wherein the number of the heat reflecting units is m, and m pivot shafts for installing the heat reflecting units are provided in the rotating device, wherein m is an integer not less than 2;

the m heat reflecting units correspond to the m pivot shafts one to one, each heat reflecting unit is fixed to a pivot shaft corresponding thereto to rotate with it, or each heat reflecting unit is provided to a pivot shaft corresponding thereto to rotate around it, so that the reflecting surface of the heating reflecting unit is made to face towards or deviate from the process chamber according to process requirements.

6. The heat reflecting device of any one of claims 1-5, wherein during the temperature-rising or temperature-maintaining period for the process chamber, the reflecting surface of the heat reflecting unit extends along the direction of the tangent line to the process chamber; during the temperature-falling period for the process chamber, the reflecting surface of the heating reflecting unit extends along the direction of the normal line to the process chamber.

7. The heat reflecting device of claim 4 or 5, wherein the rotating device comprises at least one rotation-driving source, each heat reflecting unit is connected to the rotation-driving source and is driven by the rotation-driving source to rotate.

8. The heat reflecting device of claim 7, wherein in the rotating device, corresponding to each heat reflecting unit, a rotation delivering part is provided, the rotation delivering part is connected between the rotation-driving source and the heat reflecting unit, and delivers rotation driving force from the rotation-driving source to the heat reflecting unit.

9. The heat reflecting device of claim 8, wherein there is one

rotation-driving source provided, each rotation delivering part is connected to said one rotation-driving source to deliver the rotation driving force from the rotating driving source to each heat reflecting unit.

10. The heat reflecting device of claim 1, wherein the tolerance temperature of the heat reflecting unit is 1500 ℃, and each heat reflecting unit comprises k heat-radiation reflecting mirrors which are arranged with certain intervals, wherein, k is an integer not less than 2.

11. The heat reflecting device of claim 10, wherein the heat-radiation reflecting mirror is made of copper plate, aluminum plate, steel plate or silver plate.

12. The heat reflecting device of claim 10, wherein the heat-radiation reflecting mirror consists of a base and a reflecting film on the surface of the base.

13. The heat reflecting device of claim 12, wherein the base of the heat-radiation reflecting mirror comprises a copper plate, an aluminum plate, a steel plate or a silver plate, and the reflecting film is metal plating or metal coating.

14. A semiconductor processing apparatus comprising a process chamber, wherein a heat reflecting device of any one of claims 1-13 is disposed in the periphery of the process chamber.

15. The semiconductor processing apparatus of claim 14, wherein an induction heater is provided outside the process chamber for heating the process chamber, and the heat reflecting device is provided in the periphery of the induction heater to reflect heat towards the process chamber.

16. The semiconductor processing apparatus of claim 15 wherein a tray

device for carrying substrates to be processed is provided in the process chamber.

17. The semiconductor processing apparatus of claim 16, wherein the semiconductor processing apparatus includes a crystallized film growth apparatus, the tray device comprises a plurality of trays stacked together, and there is a distance between two adjacent trays.

18. The semiconductor processing apparatus of claim 17, wherein said plurality of trays are stacked together longitudinally along the height direction of the process chamber.