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(54) **CHEMICAL VAPOR DEPOSITION APPARATUS**

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(57) **ABSTRACT**

Provided is a chemical vapor deposition apparatus including a reaction chamber, a main disk inside the reaction chamber, a satellite disk on the main disk, a lower surface of the satellite disk including a groove that has a first thickness and a first diameter, a plate in the groove, and a fixing pin configured to penetrate the plate and connected to the main disk and the satellite disk.

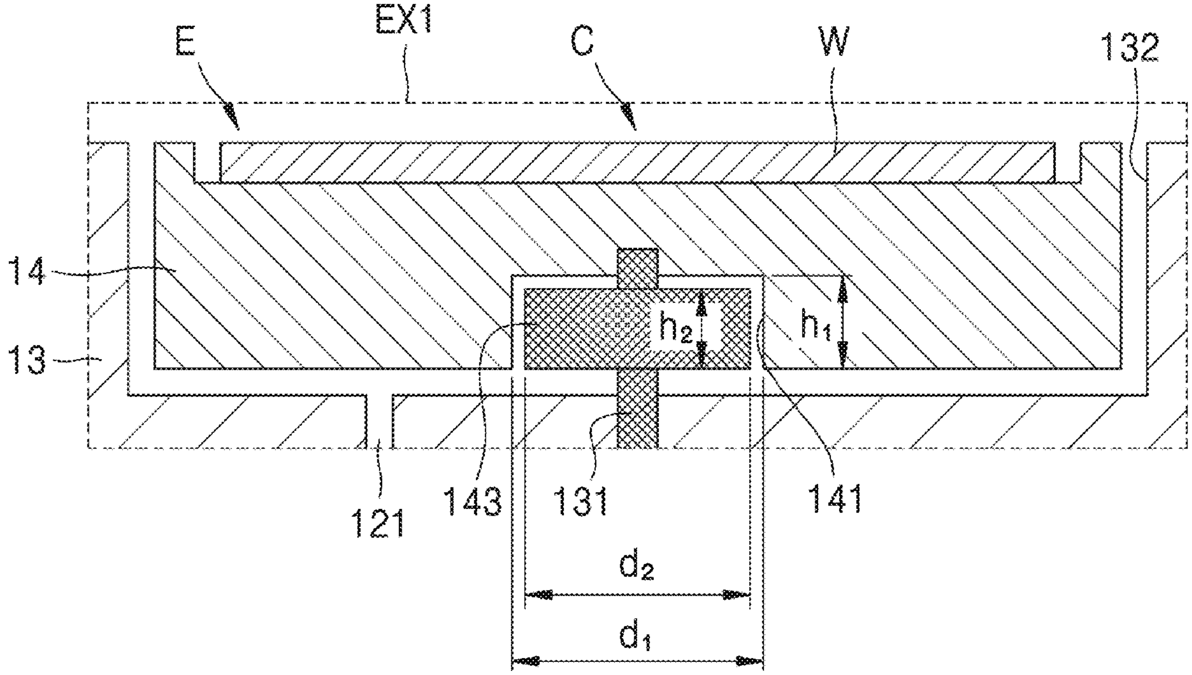

FIG. 1

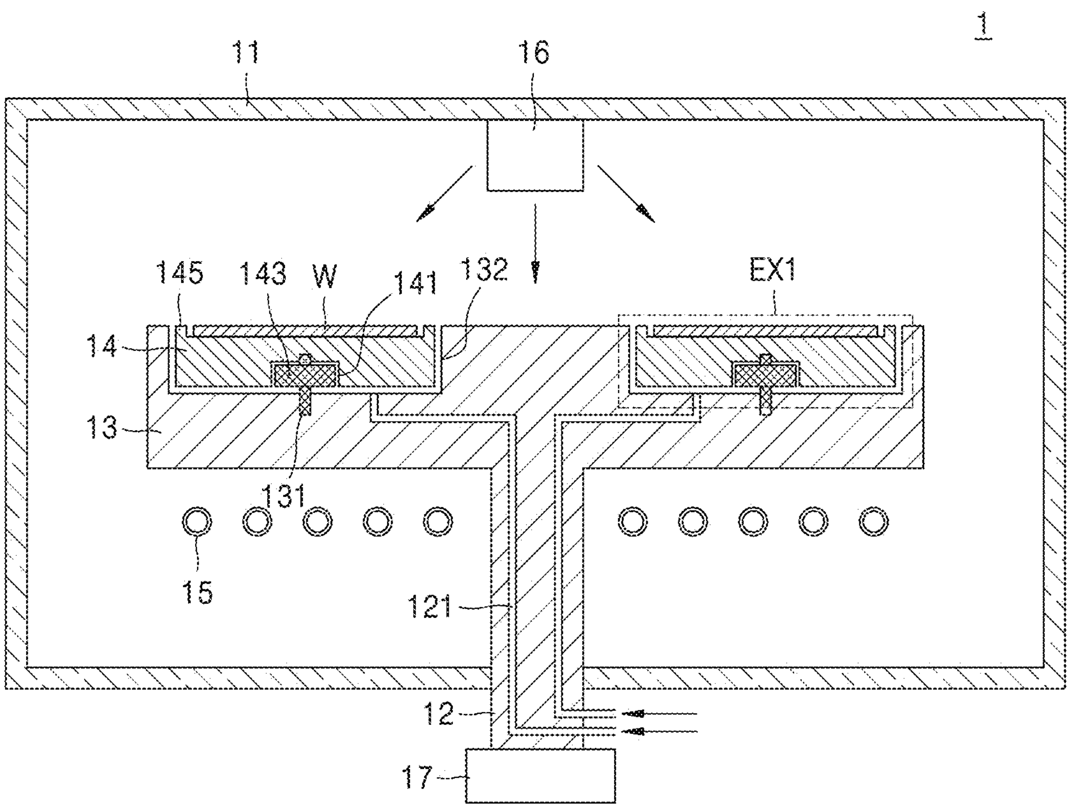

FIG. 2

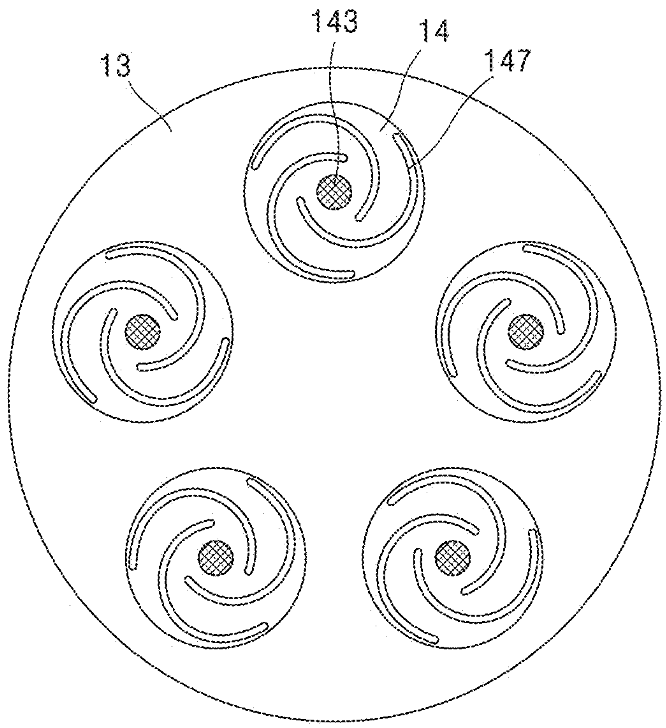

FIG. 3

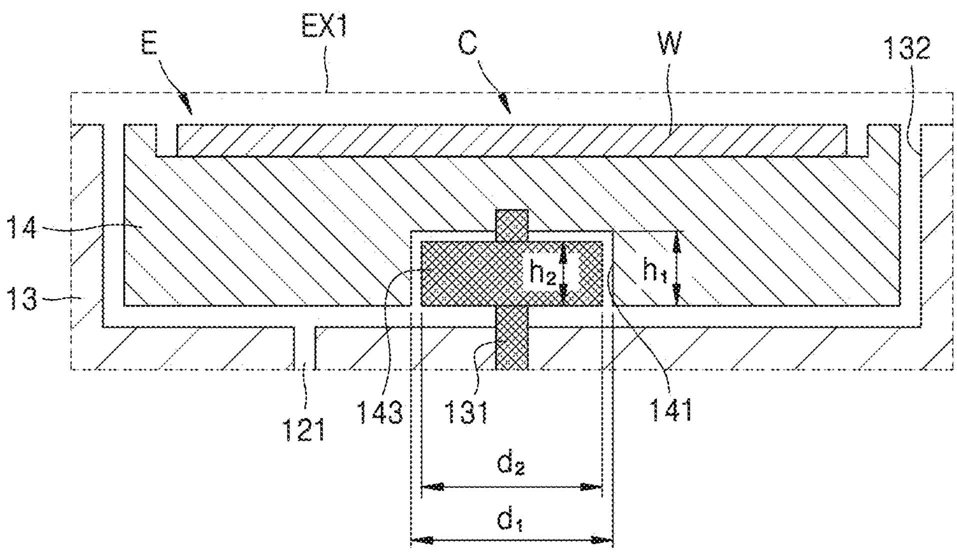

FIG. 4

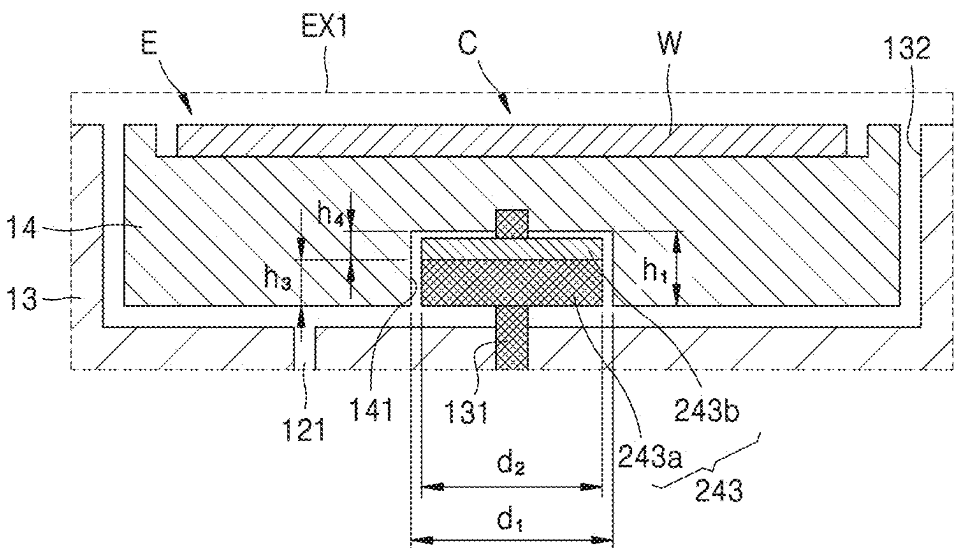

FIG. 5

	PLATE THICKNESS (mm)	EDGE TEMPERATURE (°C)	CENTER TEMPERATURE (°C)	TEMPERATURE DIFFERENCE (°C)
COMPARATIVE EXAMPLE		741.37	742.3	0.93
FIRST EMBODIMENT	0.2	741.37	742.68	1.31
SECOND EMBODIMENT	0.3	741.37	743.13	1.76
THIRD EMBODIMENT	0.4	741.36	743.53	2.17

CHEMICAL VAPOR DEPOSITION APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to Korean Patent Application No. 10-2024-0024464 filed on Feb. 20, 2024, in the Korean Intellectual Property office, the disclosure of which is incorporated by reference herein in its entirety.

BACKGROUND

1. Field

[0002] Embodiments of the present disclosure relate to a chemical vapor deposition apparatus, and more particularly, to a chemical vapor deposition apparatus including a satellite disk capable of variably controlling a temperature of a substrate.

2. Background of Related Art

[0003] A chemical vapor deposition apparatus is used for forming a thin layer on a substrate, such as a wafer, by using a chemical reaction. In general, the chemical vapor deposition apparatus is configured to inject a reaction gas at high steam pressure into a vacuum chamber in which a substrate is prepared and to grow a thin layer on the substrate by using a chemical reaction of the reaction gas.

[0004] Recently, in accordance with the high integration and high performance of semiconductor devices, chemical vapor deposition (CVD) such as metal organic CVD (MOCVD) has been widely used. Particularly, when high efficiency/high output light emitting diodes (LEDs) are manufactured, a MOCVD apparatus may be used.

SUMMARY

[0005] One or more embodiments provide a chemical vapor deposition apparatus including a satellite disk including grooves in a rear surface of the satellite disk.

[0006] According to an aspect of one or more embodiments, there is provided a chemical vapor deposition apparatus including a reaction chamber, a main disk inside the reaction chamber, a satellite disk on the main disk, a lower surface of the satellite disk including a groove that has a first thickness and a first diameter, a plate in the groove, and a fixing pin configured to penetrate the plate and connected to the main disk and the satellite disk.

[0007] According to another aspect of one or more embodiments, there is provided a chemical vapor deposition apparatus including a reaction chamber, a main disk in the reaction chamber and including a pocket, a satellite disk, a center portion of a lower surface of the satellite disk including a groove having a first thickness and a first diameter, the satellite disk being in the pocket, a fixing pin between the main disk to the plurality of satellite disks, and a plate including a through hole having a diameter equal to a diameter of the fixing pin, the plate being detachably inserted in the groove, wherein a second thickness of the plate is less than the first thickness and a second diameter of the plate is less than the first diameter.

[0008] According to still another aspect of one or more embodiments, there is provided a chemical vapor deposition apparatus including a reaction chamber, a main disk inside the reaction chamber and including a pocket, a satellite disk inside the pocket and configured to rotate, the satellite disk being configured to accommodate a substrate and including a groove having a first thickness and a first diameter in a lower surface of the satellite disk, a gas inlet configured to supply a reaction gas to the substrate, a support unit including a gas flow path through which a flow gas is supplied to the pocket, the gas flow path being configured to support the main disk to be rotatable, a fixing pin between the main disk and the satellite disk, and a plate penetrated by the fixing pin, and inserted into the groove, wherein a second thickness of the plate is less than the first thickness and a second diameter of the plate is less than the first diameter.

BRIEF DESCRIPTION OF DRAWINGS

[0009] Embodiments will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings in which:

[0010] FIG. **1** is a schematic cross-sectional view of a chemical vapor deposition apparatus according to one or more embodiments;

[0011] FIG. **2** is a schematic plan view of a satellite disk of a chemical vapor deposition apparatus according to one or more embodiments;

[0012] FIG. **3** is an enlarged cross-sectional view of region **EX1** in FIG. **1** according to one or more embodiments;

[0013] FIG. **4** is an enlarged cross-sectional view of region **EX1** in FIG. **1** according to another embodiment; and

[0014] FIG. **5** is a table showing a temperature of a substrate with respect to a plate thickness of a chemical vapor deposition apparatus, according to one or more embodiments.

DETAILED DESCRIPTION

[0015] Hereinafter, embodiments are described in detail with reference to the attached drawings. Embodiments described herein are example embodiments, and thus, the disclosure is not limited thereto.

[0016] It will be understood that, although the terms first, second, third, fourth, etc. may be used herein to describe various elements, components, regions, layers and/or sections (collectively "elements"), these elements should not be limited by these terms. These terms are only used to distinguish one element from another element. Thus, a first element described in this description section may be termed a second element or vice versa in the claim section without departing from the teachings of the disclosure.

[0017] It will be understood that when an element or layer is referred to as being "over," "above," "on," "below," "under," "beneath," "connected to" or "coupled to" another element or layer, it can be directly over, above, on, below, under, beneath, connected or coupled to the other element or layer or intervening elements or layers may be present. In contrast, when an element is referred to as being "directly over," "directly above," "directly on," "directly below," "directly under," "directly beneath," "directly connected to" or "directly coupled to" another element or layer, there are no intervening elements or layers present.

[0018] As used herein, an expression "at least one of" preceding a list of elements modifies the entire list of the elements and does not modify the individual elements of the list. For example, an expression, "at least one of a, b, and c" should be understood as including only a, only b, only c, both a and b, both a and c, both b and c, or all of a, b, and c.

[0019] FIG. **1** is a schematic cross-sectional view of a chemical vapor deposition apparatus according to one or more embodiments.

[0020] FIG. **2** is a schematic plan view of a satellite disk of the chemical vapor deposition apparatus **1** according to one or more embodiments.

[0021] FIG. **3** is an enlarged cross-sectional view of region EX**1** in FIG. **1** according to one or more embodiments.

[0022] Referring to FIGS. **1** through **3**, a chemical vapor deposition apparatus **1** according to one or more embodiments may include a reaction chamber **11**, a support unit **12**, a main disk **13**, a satellite disk **14**, a heater **15**, a gas inlet **16**, and a driving motor **17**.

[0023] In one or more embodiments, the reaction chamber **11** may include a ceiling and sidewalls, and may have a certain inner space. The main disk **13** may be arranged inside the reaction chamber **11**. The main disk **13** may have a circular disk shape. In this case, the main disk **13** may include a susceptor on which a substrate W may be mounted. The substrate W may include a semiconductor wafer.

[0024] In one or more embodiments, the main disk **13** may be arranged inside the reaction chamber **11** to be rotatable by the support unit **12**. The driving motor **17** may support and rotate the support unit **12**. Therefore, the main disk **13** may be rotated inside the reaction chamber **11**. For example, the main disk **13** may rotate clockwise or counterclockwise according to the driving of the driving motor **17** with the support unit **12** as the center axis.

[0025] In one or more embodiments, the support unit **12** may include a hollow shaft or a rod. A gas flow path **121** may be provided in the support unit **12** to supply the flow gas to a pocket **132**.

[0026] In one or more embodiments, a plurality of pockets **132** may be arranged on an upper surface of the main disk **13**. Each of the plurality of pockets **132** may accommodate the satellite disk **14**. The plurality of pockets **132** may be formed to be recessed in a vertical direction from the upper surface of the main disk **13**. Each of the plurality of pockets **132** may have substantially the same shape as the satellite disk **14** to accommodate the satellite disk **14**. For example, the plurality of pockets **132** may have a cylindrical shape. In FIG. **2**, the chemical vapor deposition apparatus **1** according to one or more embodiments is illustrated as including five satellite disks **14** on one main disk **13**, but embodiments are not limited thereto.

[0027] In one or more embodiments, the satellite disk **14** may be arranged inside each of the plurality of pockets **132**. The satellite disk **14** may be arranged to rotate inside the pocket **132**. In this case, the satellite disk **14** and the main disk **13** may be connected to each other by using a fixing pin **131**. The fixing pin **131** may be connected to a lower center of the satellite disk **14**. The satellite disk **14** may rotate in a clockwise or counterclockwise direction with the fixing pin **131** as a center axis. In addition, the fixing pin **131** may be arranged so that the satellite disk **14** is spaced apart from a lower surface of the pocket **132** by a certain height in a vertical direction.

[0028] In one or more embodiments, the gas flow path **121** may be arranged inside the main disk **13** and the support unit **12**. The gas flow path **121** may supply the flow gas from the gas supply means to the pocket **132**. A plurality of spiral grooves **147** may be arranged on the lower surface of the pocket **132**. The plurality of spiral grooves **147** may have a spiral shape. The flow gas discharged from the gas flow path **121** through the plurality of spiral grooves **147** may rotate in a certain direction. The satellite disk **14** may rotate according to the flow gas proceeding through the plurality of spiral grooves **147**. In addition, the satellite disk **14** may be spaced apart from the lower surface of the pocket **132** by a certain height in the vertical direction and rotate by the flow gas. In this case, nitrogen, water, or the like may be used as the flow gas, but embodiments are not limited thereto. In addition, the rotation of the satellite disk **14** may be controlled by adjusting the flow rate of the flow gas.

[0029] In one or more embodiments, a deposition target such as the substrate W may be arranged on the satellite disk **14**. In this case, a fixing ring **145** may be arranged at an edge of the satellite disk **14** so that the substrate W does not move. The fixing ring **145** may be arranged on the satellite disk **14** to surround the edge of the substrate W seated on the satellite disk **14**. The fixing ring **145** may fix the substrate W seated on the satellite disk **14**. In this case, the fixing ring **145** may have an annular shape, but embodiments are not limited thereto. The fixing ring **145** may have various shapes according to the shape of the satellite disk **14**. The fixing ring **145** may be integrally formed with the satellite disk **14**, but embodiments are not limited thereto.

[0030] In one or more embodiments, the heater **15** may be arranged below the main disk **13**. The heater **15** may heat the main disk **13** to a certain temperature. The heater **15** may heat the main disk **13** from several hundred degrees in centigrade to a temperature greater than or equal to about 1000° C. For example, when a gallium nitride (GaN)-based growth layer is formed, the heater **15** may heat the main disk **13** to about 700° C. to about 1300° C. The heater **15** may include a coil to which a high frequency current is applied, and in this case, the main disk **13** may be heated in an induction heating method. In one or more other embodiments, the heater **15** may include a conductive wire which generates resistance heat.

[0031] The main disk **13** and the satellite disk **14** may transfer heat from the heater **15** to the substrate W arranged on the satellite disk **14**. Accordingly, the main disk **13** and the satellite disk **14** may be formed of a material having durability capable of withstanding a heating temperature generated by the heater **15**. For example, the main disk **13** and the satellite disk **14** may be formed of graphite. To enhance durability, a hardness reinforcement coating layer, for example, a silicon carbide (SiC) coating layer may be formed on the main disk **13** and the satellite disk **14**.

[0032] In one or more embodiments, the gas inlet **16** may include a device supplying the reaction gas to be deposited on the substrate W. The reaction gas may include a source gas and a carrier gas. The gas inlet **16** may be attached to an upper portion of the reaction chamber **11** to supply the reaction gas into the reaction chamber **11** via a nozzle.

[0033] In one or more embodiments, the substrate W may maintain a relatively high temperature by using the main disk **13** heated to a relatively high temperature, and the reaction gas may contact an upper surface of the substrate W to perform a chemical deposition reaction. For example, a chemical deposition reaction may be performed on the upper surface of the substrate W to deposit and grow a growth layer such as a GaN-based growth layer.

[0034] Only a portion of the reaction gas supplied into the reaction chamber **11** may be used to deposit a growth layer on the substrate W, and the remainder of the reaction gas may be discharged from the reaction chamber **11**. In addition, the flow gas may also be discharged from the reaction chamber **11** after being used to rotate the satellite disk **14**. The reaction gas and the flow gas may be discharged from the inside of the reaction chamber **11** via a gas discharging unit.

[0035] Warpage may occur in a substrate and a growth layer in a conventional chemical vapor deposition apparatus due to differences in a lattice constant and a thermal expansion rate between the substrate and the layer growing on the substrate. Due to the warpage, a temperature non-uniformity may occur on a surface of the substrate, accordingly, the composition of the growth layer growing thereon may become non-uniform, and as a result, non-uniformity in a thickness and wavelength of the growth layer may increase. The non-uniformly grown growth layer may cause a light emitting wavelength and electrical characteristics of a semiconductor light emitting device including the non-uniformly grown growth layer become non-uniform, and a decrease in quality, performance, and yield may occur.

[0036] In one or more embodiments, the satellite disk **14** of the chemical vapor deposition apparatus **1** according to one or more embodiments may include a groove **141**. The groove **141** may be arranged in the center portion of a lower surface of the satellite disk **14**. The groove **141** may be arranged on the lower surface of the satellite disk **14**, and may be arranged in the center portion of the satellite disk **14** to be concentric with the satellite disk **14**. For example, the groove **141** may have a cylindrical shape, and in this case, the groove **141** may have a first thickness h_1 and a first diameter d_1. However, the shape of the groove **141** is not limited thereto, and may be variously designed as necessary. In this case, the first thickness h_1 may be designed to be less than a thickness of the satellite disk **14** in the vertical direction. For example, the first thickness h_1 may be in a range of about 0.45 mm to about 1 mm. In this case, the first diameter d_1 may be designed to be less than the diameter of the satellite disk **14** in a horizontal direction perpendicular to the vertical direction. For example, the first diameter d_1 may be less than about 40 mm.

[0037] In one or more embodiments, each of the plurality of satellite disks **14** may include the groove **141**. In this case, the diameters or thicknesses of the grooves **141** included in the different satellite disks **14** from each other may be the same. However, the embodiments are not limited thereto, and the diameters or thicknesses of the grooves **141** included in the different satellite disks **14** from each other may also be different.

[0038] In one or more embodiments, the chemical vapor deposition apparatus **1** according to one or more embodiments may further include a plate **143**. The plate **143** may be arranged to be inserted into the groove **141**. The plate **143** may include a through hole, and the fixing pin **131** may penetrate the through hole. The fixing pin **131** may fix the plate **143** to be seated inside the groove **141** of the satellite disk **14**. In this case, the diameter of the through hole and the diameter of the fixing pin **131** may be the same. For example, the diameter of the through hole and the diameter of the fixing pin **131** may be about 2.5 mm.

[0039] In one or more embodiments, the plate **143** may have a second thickness h_2 and a second diameter d_2. In this case, the second thickness h_2 may be less than the first thickness h_1. For example, the second thickness h_2 may be about 0.2 mm to about 0.4 mm, but embodiments are not limited thereto. In addition, the second diameter d_2 may be less than the first diameter d_1. For example, the second diameter d_2 may be about 38 mm, but embodiments are not limited thereto. Because the second thickness h_2 and the second diameter d_2 of the plate **143** are less than the first thickness h_1 and the first diameter d**1** of the groove **141**, respectively, a certain space may be formed between the plate **143** and the groove **141**.

[0040] In one or more embodiments, the plate **143** may include a material having high thermal conductivity. For example, the plate **143** may include silicon carbide (SiC), but embodiments are not limited thereto.

[0041] The chemical vapor deposition apparatus **1** according to one or more embodiments may compensate for the temperature of the center C of the substrate W, by forming a groove **141** at the center of the lower surface of the satellite disk **14** and inserting and arranging the plate **143** into the groove **141**. By compensating for the temperature of the center C of the substrate W, the non-uniformity in the thickness and wavelength of the growth layer grown on the substrate W may be reduced, and thus, by making the light emitting wavelength and electrical characteristics of the light emitting device uniform, the quality, performance, and yield of the substrate W may be increased.

[0042] The chemical vapor deposition apparatus **1** according to one or more embodiments may variably control the temperature of the substrate W, by variously controlling the plate **143** inserted into and arranged in the groove **141**. In particular, by inserting and arranging the plate **143** having different sizes and physical properties from the groove **141** into the groove **141**, the temperature of the center C of the substrate W may be variably controlled. The temperature of the center C of the substrate W may be more precisely controlled according to the physical properties, diameter, and thickness of the plate **143**. The thermal conductivity of the plate **143** may vary according to the physical properties, diameter, and thickness thereof. The temperature transmitted to the substrate W may be controlled by replacing the plate **143** having different physical properties, diameters, or thicknesses and arranging the replaced plate **143** inside the groove **141**. As a result, by variably controlling the temperature of the center C of the substrate W, the temperature of the center C of the substrate W and the temperature deviation at an edge E of the substrate W may be more precisely controlled.

[0043] In one or more embodiments, the temperature of the center portion of the substrate W may be changed by using a change in thermal conduction according to the physical properties of the plate **143**. For example, when the thickness of the plate **143** increases or a material having relatively high thermal conductivity is used, the temperature of the center of the substrate W may be increased.

[0044] In one or more embodiments, the satellite disk **14** may use a material that forms a SiC coating layer on graphite having a thermal conductivity of about 273 W/mk. In addition, the plate **143** may include a diamond material having a thermal conductivity of about 2200 W/mk, which is about 10 times higher than that of the satellite disk **14**. By arranging the plate **143** having a higher thermal conductivity than the satellite disk **14** in the groove **141**, the temperature of the center portion of the substrate W may be increased.

[0045] In one or more embodiments, the plate **143** of the chemical vapor deposition apparatus **1** according to one or more embodiments may be configured to be detachably attached to the groove **141**. The plate **143** having a different size and physical properties may be replaced and arranged in the groove **141** according to process conditions. For example, when the temperature of the center portion of the substrate W is relatively low compared to the temperature of the edge portion of the substrate W, the plate **143** may be replaced with a plate having high thermal conductivity and arranged in the groove **141**.

[0046] In one or more embodiments, by replacing the plate **143** having a different size and physical properties as needed and arranging in the groove **141**, wavelength control may be more precisely performed, and process cost may be reduced compared to changing the entire facility. In this case, according to a change in the first thickness h_1 of the groove **141**, the second thickness h_2 of the plate **143** may be variably designed.

[0047] FIG. **4** is an enlarged cross-sectional view of region EX**1** in FIG. **1** according to one or more other embodiments.

[0048] In a chemical vapor deposition apparatus of FIG. **4**, except for the configuration of a plate **243**, the configuration of the chemical vapor deposition apparatus **1** described with reference to FIGS. **1** through **3** is substantially the same, and thus differences are mainly described.

[0049] Referring to FIG. **4**, the plate **243** may include a first plate **243***a* and a second plate **243***b*. Although FIG. **4** illustrates that the plate **243** includes two plates (**243***a* and **243***b*), embodiments are not limited thereto.

[0050] In one or more embodiments, the first plate **243***a* and the second plate **243***b* may be arranged to be inserted into the groove **141**. Each of the first plate **243***a* and the second plate **243***b* may include a through hole, and the fixing pin **131** may penetrate the through hole. The fixing pin **131** may fix the first plate **243***a* and the second plate **243***b* to be seated in the groove **141** of the satellite disk **14**. In this case, the diameter of the through hole and the diameter of the fixing pin **131** may be the same. The diameter of the through hole and the diameter of the fixing pin **131** may be about 2.5 mm.

[0051] In one or more embodiments, the first plate **243***a* may include a first material having a first property, and the second plate **243***b* may include a second material having a second property that may be different from the first property. In this case, the second material may include a material having a thermal conductivity that is different from a thermal conductivity of the first material, but embodiments are not limited thereto. For example, the first material may include SiC, and the second material may include diamond (C).

[0052] In one or more embodiments, the first plate **243***a* may have a third thickness h_3, and the second plate **243***b* may have a fourth thickness h**4**. In this case, a sum of the third thickness h_3 and the fourth thickness h_4 may be less than the first thickness h**1**. For example, the sum of the third thickness h_3 and the fourth thickness h_4 may be about 0.2 mm to about 0.4 mm, but embodiments are not limited thereto.

[0053] In one or more embodiments, the first plate **243***a* and the second plate **243***b* may each have a second diameter d_2. In addition, the second diameter d_2 may be less than the first diameter d_1. For example, the second diameter d_2 may be about 38 mm, but embodiments are not limited thereto. For example, the first plate **243***a* and the second plate **243***b* may also have different diameters. In this case, a certain space may be formed between the plate **243** and the groove **141**.

[0054] The chemical vapor deposition apparatus **1** according to one or more embodiments may variably control the temperature of the substrate W, by variously controlling the plate **243** inserted into and arranged in the groove **141**. In particular, by inserting and arranging the first plate **243***a* and the second plate **243***b* having different sizes and physical properties into the groove **141**, the temperature of the center C of the substrate W may be variably controlled. The temperature of the center C of the substrate W may be precisely controlled according to the physical properties, diameters, and thicknesses of the first plate **243***a* and the second plate **243***b*. In this case, only the first plate **243***a* or the second plate **243***b* may be selectively replaced and arranged.

[0055] The thermal conductivity of the plate **243** may vary according to the physical properties, diameters, and thicknesses of the first plate **243***a* and the second plate **243***b*. The temperature transmitted to the substrate W may be controlled by replacing the plate **243** having different physical properties, diameters, or thicknesses and arranging the replaced plate **243** inside the groove **141**. As a result, by variably controlling the temperature of the center C of the substrate W, the temperature of the center C of the substrate W and the temperature deviation at an edge E of the substrate W may be more precisely controlled.

[0056] In one or more embodiments, the temperature of the center portion of the substrate W may be changed by using a change in thermal conduction according to the physical properties of the plate **243**. For example, when the thickness of the plate **243** increases or a material having relatively high thermal conductivity is used, the temperature of the center of the substrate W may be increased. In one or more embodiments, the plate **243** of the chemical vapor deposition apparatus **1** according to one or more embodiments may be configured to be detachably attached to the groove **141**. The plate **243** having a different size and physical properties may be replaced and arranged in the groove **141** according to process conditions. For example, when the temperature of the center portion of the substrate W is relatively low compared to the temperature of the edge portion of the substrate W, the plate **143** may be replaced with a plate having high thermal conductivity and arranged in the groove **141**. In this case, only the first plate **243***a* may be replaced, only the second plate **243***b* may be replaced, or the first plate **243***a* and the second plate **243***b* may be replaced together.

[0057] In one or more embodiments, by replacing the plate **243** having a different size and physical properties as needed and arranging in the groove **141**, wavelength control may be precisely performed, and process cost may be reduced compared to changing the entire facility. In this case, according to a change in the first thickness h_1 of the groove **141**, the second thickness h_2 of the plate **243** may be variably designed.

[0058] FIG. **5** is a table showing a temperature of a substrate with respect to a plate thickness of the chemical vapor deposition apparatus **1**, according to one or more embodiments.

[0059] Referring to FIGS. **1** and **5**, in the chemical vapor deposition apparatus **1** according to one or more embodiments, it may be identified that the temperature of the center (refer to C in FIG. **3**) and the temperature of the edge (refer to E in FIG. **3**) of the substrate W change according to the thickness of the plate **143**. In this case, the plate **143** may include SiC.

[0060] The related example uses a conventional chemical vapor deposition apparatus without a plate, and in this case, it may be identified that the edge temperature of the substrate W is about 741.37° C. and the center temperature of the substrate W is about 742.3° C. Accordingly, it may be identified that the difference between the edge temperature of the substrate and the center temperature of the substrate is about 0.93° C.

[0061] A first embodiment may be the chemical vapor deposition apparatus **1** according to one or more embodiments, in which the second thickness h_2 of the plate **143** is about 0.2 mm. In this case, it may be identified that the center C temperature of the substrate W is about 741.37° C. and the edge E temperature of the substrate W is about 742.68° C. Accordingly, it may be identified that the difference between the temperature of the edge E of the substrate W and the temperature of the center C of the substrate W is about 1.31° C.

[0062] A second embodiment may be the chemical vapor deposition apparatus **1** according to one or more embodiments, in which the second thickness h_2 of the plate **143** is about 0.3 mm. In this case, it may be identified that the center C temperature of the substrate W is about 741.37° C. and the edge E temperature of the substrate W is about 743.13° C. Accordingly, it may be identified that the difference between the temperature of the edge E of the substrate W and the temperature of the center C of the substrate W is about 1.76° C.

[0063] A third embodiment may be the chemical vapor deposition apparatus **1** according to one or more embodiments, in which the second thickness h_2 of the plate **143** is about 0.4 mm. In this case, it may be identified that the center C temperature of the substrate W is about 741.36° C. and the edge E temperature of the substrate W is about 743.53° C. Accordingly, it may be identified that the difference between the temperature of the edge E of the substrate W and the temperature of the center C of the substrate W is about 2.17° C.

[0064] In the three embodiments, it may be identified that as the thickness of the plate **143** increases, the temperature of the edge E of the substrate W is constant, but the temperature of the center C of the substrate W increases. Thus, as the thickness of the plate **143** increases, the difference between the temperature of the edge E of the substrate W and the temperature of the center C of the substrate W may increase.

[0065] The chemical vapor deposition apparatus **1** according to one or more embodiments may compensate for the temperature of the center C of the substrate W, by forming a groove **141** at the center of the lower surface of the satellite disk **14** and inserting and arranging the plate **143** into the groove **141**. By compensating for the temperature of the center C of the substrate W, the non-uniformity in the thickness and wavelength of the growth layer grown on the substrate W may be reduced, and thus, by making the light emitting wavelength and electrical characteristics of the light emitting device uniform, the quality, performance, and yield of the substrate W may be increased.

[0066] In addition, by replacing and arranging the plate **143** having a different size and physical properties into the groove **141**, the temperature of the center C of the substrate W may be variably controlled. Because the thermal conductivity of the plate **143** changes according to the physical properties, diameter, and thickness of the plate **143**, the temperature of the center C of the substrate W may be more precisely controlled. As a result, by variably controlling the temperature of the center C of the substrate W, the temperature of the center C of the substrate W and the temperature deviation at an edge E of the substrate W may be precisely controlled.

[0067] While embodiments have been described with reference to the figures, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope as defined by the following claims and their equivalents.

What is claimed is:

1. A chemical vapor deposition apparatus comprising:
- a reaction chamber;
- a main disk inside the reaction chamber;
- a satellite disk on the main disk, a lower surface of the satellite disk comprising a groove that has a first thickness and a first diameter;
- a plate in the groove; and
- a fixing pin configured to penetrate the plate and connected to the main disk and the satellite disk.

2. The chemical vapor deposition apparatus of claim **1**, wherein the groove is at a center portion of the lower surface of the satellite disk and concentric with the satellite disk.

3. The chemical vapor deposition apparatus of claim **1**, wherein a second thickness of the plate is less than the first thickness, and
- wherein a second diameter of the plate is less than the first diameter.

4. The chemical vapor deposition apparatus of claim **1**, wherein the plate comprises a through hole, and
- wherein a diameter of the through hole is equal to a diameter of the fixing pin.

5. The chemical vapor deposition apparatus of claim **1**, wherein the plate comprises a first plate and a second plate, and
- wherein a thermal conductivity of the first plate is different from a thermal conductivity of the second plate.

6. The chemical vapor deposition apparatus of claim **5**, wherein the first plate has a third thickness and a third diameter, and
- wherein the second plate has a fourth thickness and a fourth diameter.

7. The chemical vapor deposition apparatus of claim **1**, wherein the plate includes silicon carbide.

8. The chemical vapor deposition apparatus of claim **1**, wherein the first thickness is less than a thickness of the satellite disk.

9. The chemical vapor deposition apparatus of claim **1**, wherein a thermal conductivity of the plate is greater than a thermal conductivity of the satellite disk.

10. A chemical vapor deposition apparatus comprising:
- a reaction chamber;
- a main disk in the reaction chamber and comprising a pocket;
- a satellite disk, a center portion of a lower surface of the satellite disk comprising a groove having a first thickness and a first diameter, the satellite disk being in the pocket;

a fixing pin between the main disk to the satellite disk; and

a plate comprising a through hole having a diameter equal to a diameter of the fixing pin, the plate being detachably inserted in the groove,

wherein a second thickness of the plate is less than the first thickness and a second diameter of the plate is less than the first diameter.

11. The chemical vapor deposition apparatus of claim **10**, wherein the plate includes silicon carbide.

12. The chemical vapor deposition apparatus of claim **10**, wherein the plate comprises a first plate and a second plate, and

wherein a thermal conductivity of the first plate is different from a thermal conductivity of the second plate.

13. The chemical vapor deposition apparatus of claim **12**, wherein the first plate has a third thickness and a third diameter, and

wherein the second plate has a fourth thickness and a fourth diameter.

14. The chemical vapor deposition apparatus of claim **10**, wherein a thermal conductivity of the plate is greater than a thermal conductivity of the satellite disk.

15. A chemical vapor deposition apparatus comprising:

a reaction chamber;

a main disk inside the reaction chamber and comprising a pocket;

a satellite disk inside the pocket and configured to rotate, the satellite disk being configured to accommodate a substrate and comprising a groove having a first thickness and a first diameter in a lower surface of the satellite disk;

a gas inlet configured to supply a reaction gas to the substrate;

a support unit comprising a gas flow path through which a flow gas is supplied to the pocket, the gas flow path being configured to support the main disk to be rotatable;

a fixing pin between the main disk and the satellite disk; and

a plate penetrated by the fixing pin, and inserted into the groove,

wherein a second thickness of the plate is less than the first thickness and a second diameter of the plate is less than the first diameter.

16. The chemical vapor deposition apparatus of claim **15**, wherein the groove is at a center portion of the lower surface of the satellite disk and concentric to the satellite disk.

17. The chemical vapor deposition apparatus of claim **15**, wherein the plate includes silicon carbide.

18. The chemical vapor deposition apparatus of claim **15**, wherein the plate comprises a first plate and a second plate, and

wherein a thermal conductivity of the first plate is different from a thermal conductivity of the second plate.

19. The chemical vapor deposition apparatus of claim **18**, wherein the first plate has a third thickness and a third diameter, and

wherein the second plate has a fourth thickness and a fourth diameter.

20. The chemical vapor deposition apparatus of claim **14**, wherein thermal conductivity of the plate is greater than thermal conductivity of the satellite disk.

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