US 20240234177A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2024/0234177 A1**

PARK et al. (43) **Pub. Date: Jul. 11, 2024**

(54) **WAFER PROCESSING APPARATUS**

(71) Applicant: **Samsung Electronics Co., Ltd.**, Suwon-si (KR)

(72) Inventors: **Hun Yong PARK**, Suwon-si (KR); **Yeon Tae KIM**, Suwon-si (KR); **Jang Hwi LEE**, Suwon-si (KR); **Sang Woo BAE**, Suwon-si (KR); **Kyung Su KIM**, Suwon-si (KR); **Tae Soon PARK**, Suwon-si (KR); **Jung Chul LEE**, Suwon-si (KR); **Sung Ho JANG**, Suwon-si (KR); **Won Don JOO**, Suwon-si (KR)

(73) Assignee: **Samsung Electronics Co., Ltd.**, Suwon-si (KR)

(21) Appl. No.: **18/495,224**

(22) Filed: **Oct. 26, 2023**

(30) **Foreign Application Priority Data**

Jan. 10, 2023 (KR) 10-2023-0003504

Publication Classification

(51) **Int. Cl.**

H01L 21/67	(2006.01)
C23C 16/44	(2006.01)
C23C 16/452	(2006.01)
H01L 21/02	(2006.01)

(52) **U.S. Cl.**

CPC ***H01L 21/67115*** (2013.01); ***C23C 16/4412*** (2013.01); ***C23C 16/452*** (2013.01); ***H01L 21/0228*** (2013.01)

(57) **ABSTRACT**

A wafer processing apparatus may include a chamber providing an internal space; and a first rib on an outer side of a first sidewall of the chamber. An outer side of the first rib may include a first portion and a second portion. A light transmittance of the first portion may be different from a light transmittance of the second portion.

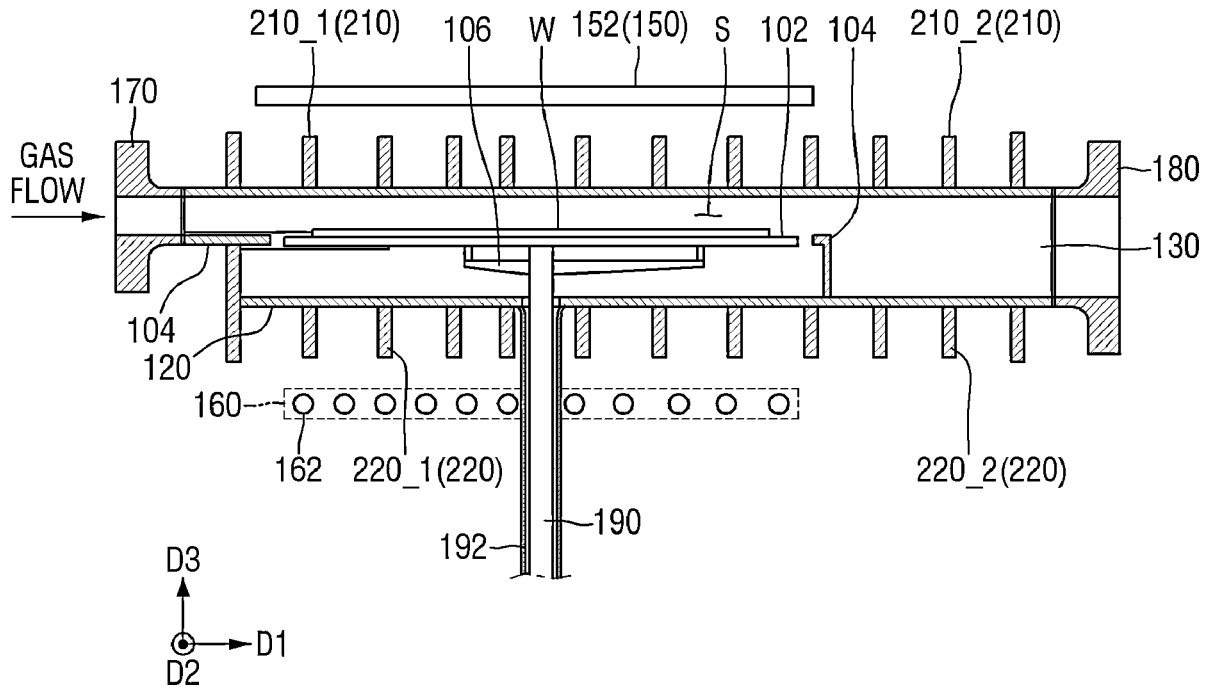


FIG. 1

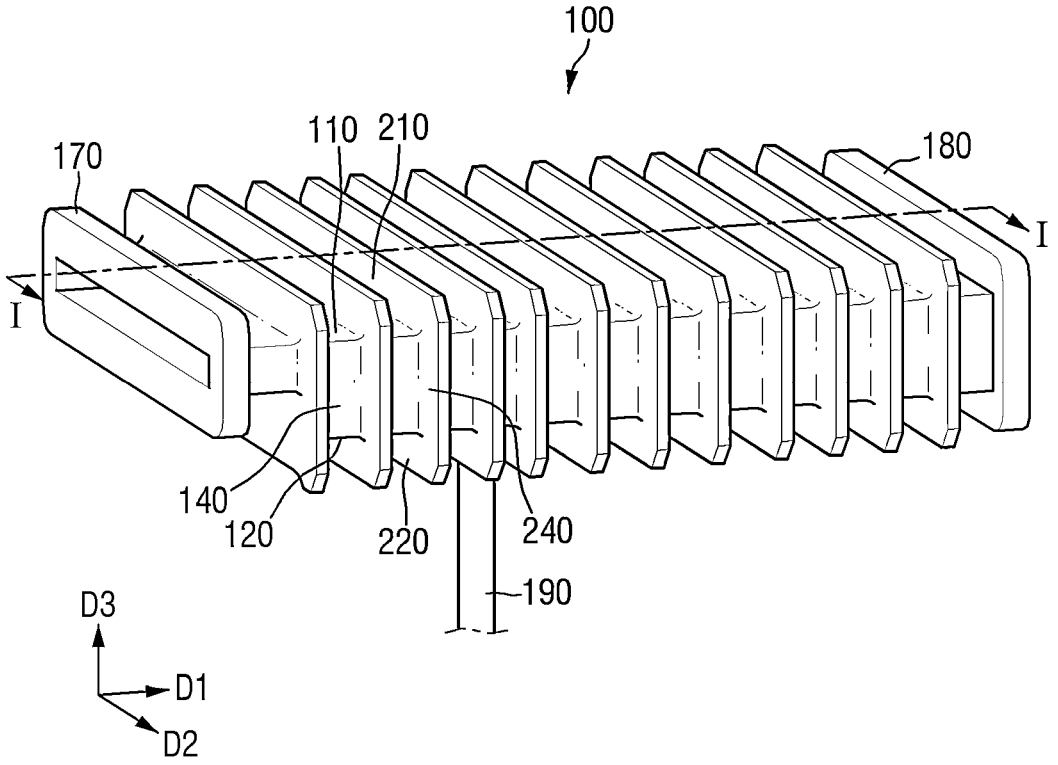

100
170
110
210
180
I
I
140
120
220
240
190
D3
D1
D2

FIG. 2

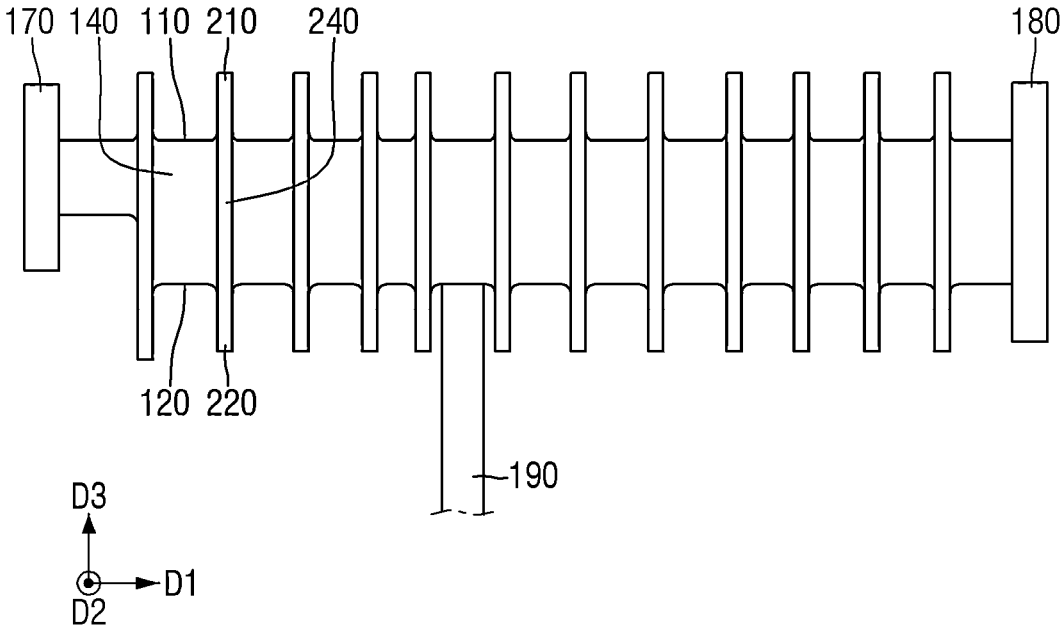

170
140
110
210
240
180
120
220
190
D3
D1
D2

FIG. 3

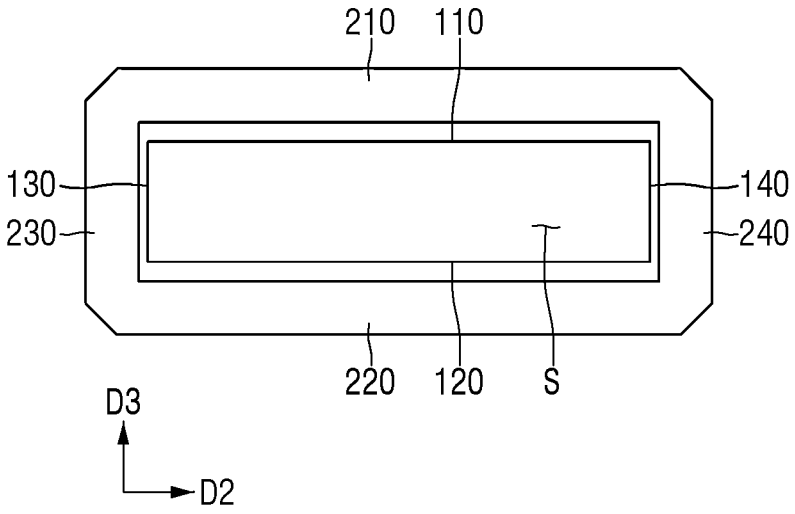

210
110
130
140
230
240
220
120
S
D3
D2

FIG. 4

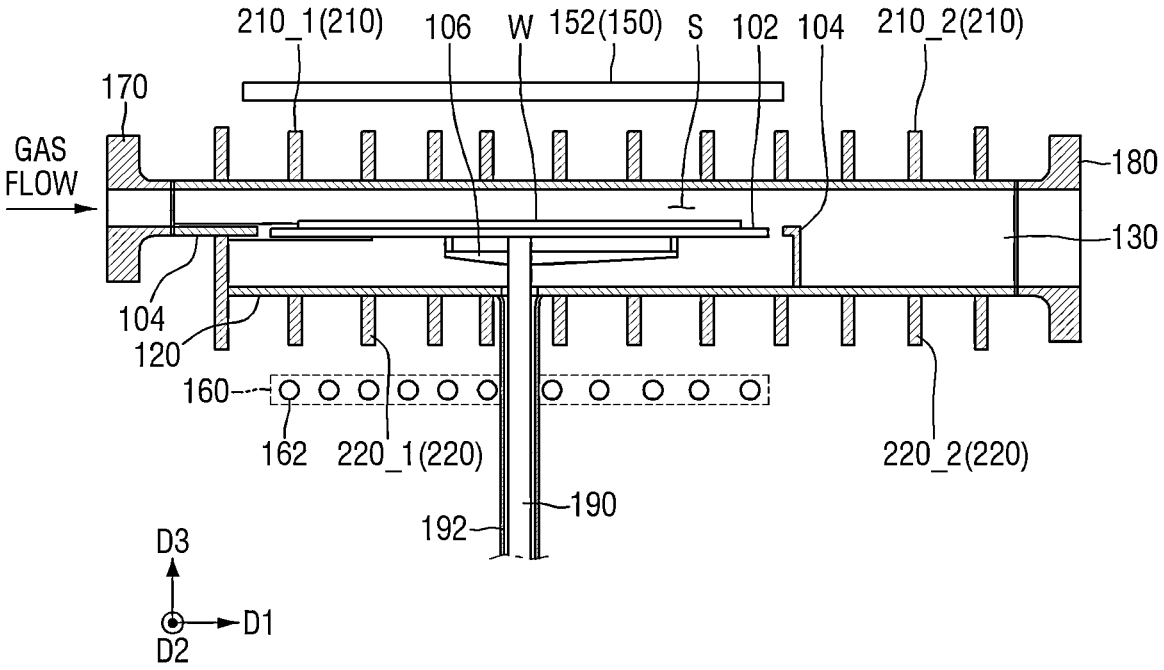

210_1(210)
106
W
152(150)
S
102
104
210_2(210)
170
GAS FLOW
180
130
104
120
160
162
220_1(220)
220_2(220)
190
192
D3
D1
D2

FIG. 5

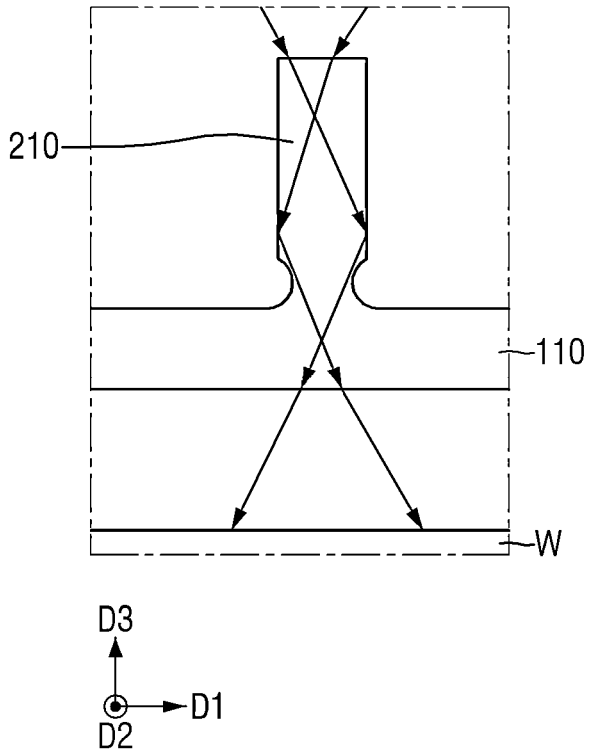


FIG. 6

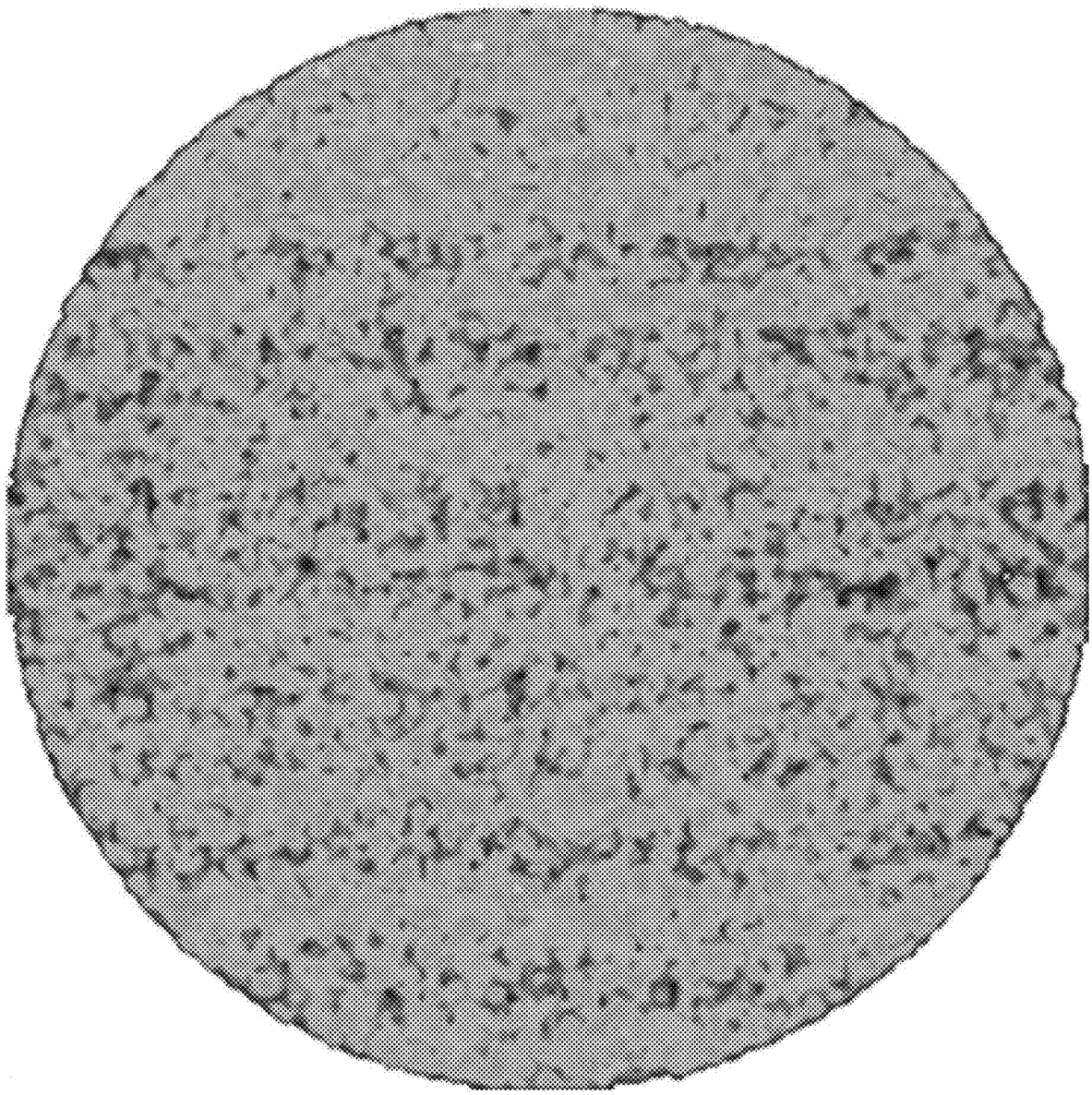


FIG. 7

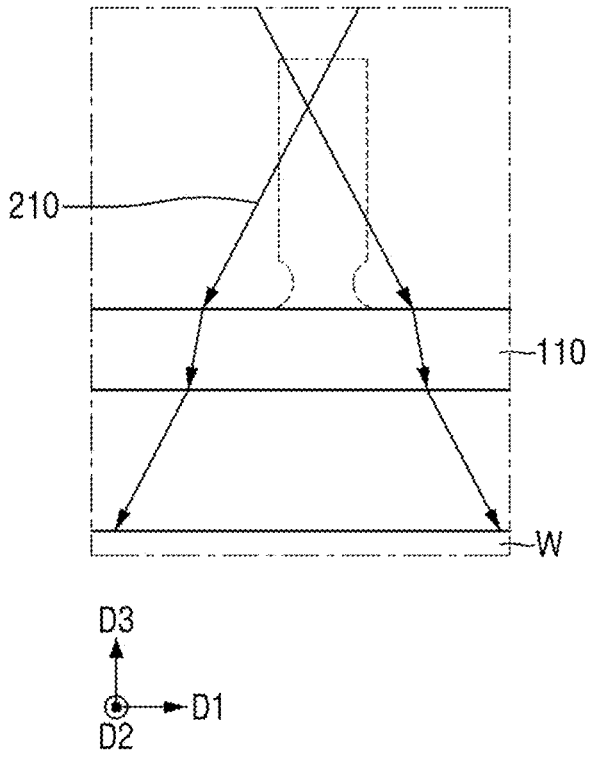


FIG. 8

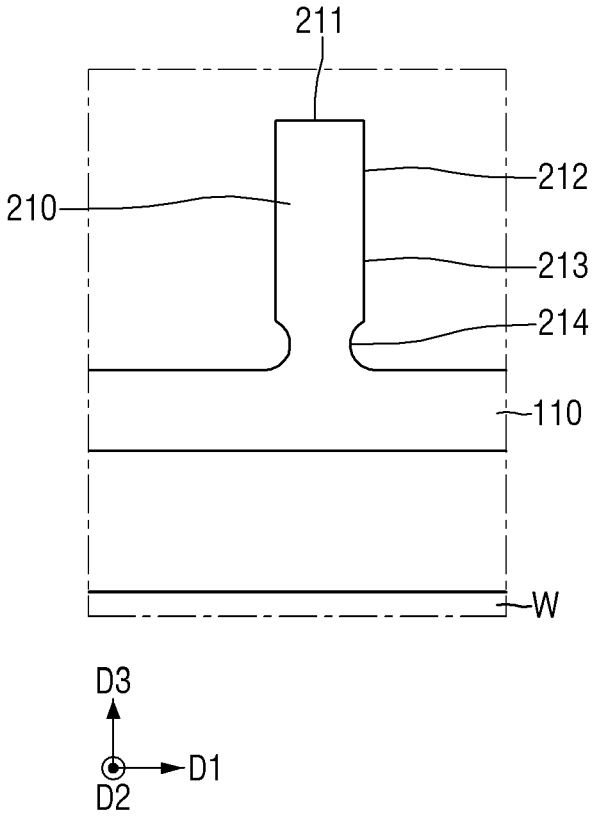


FIG. 9

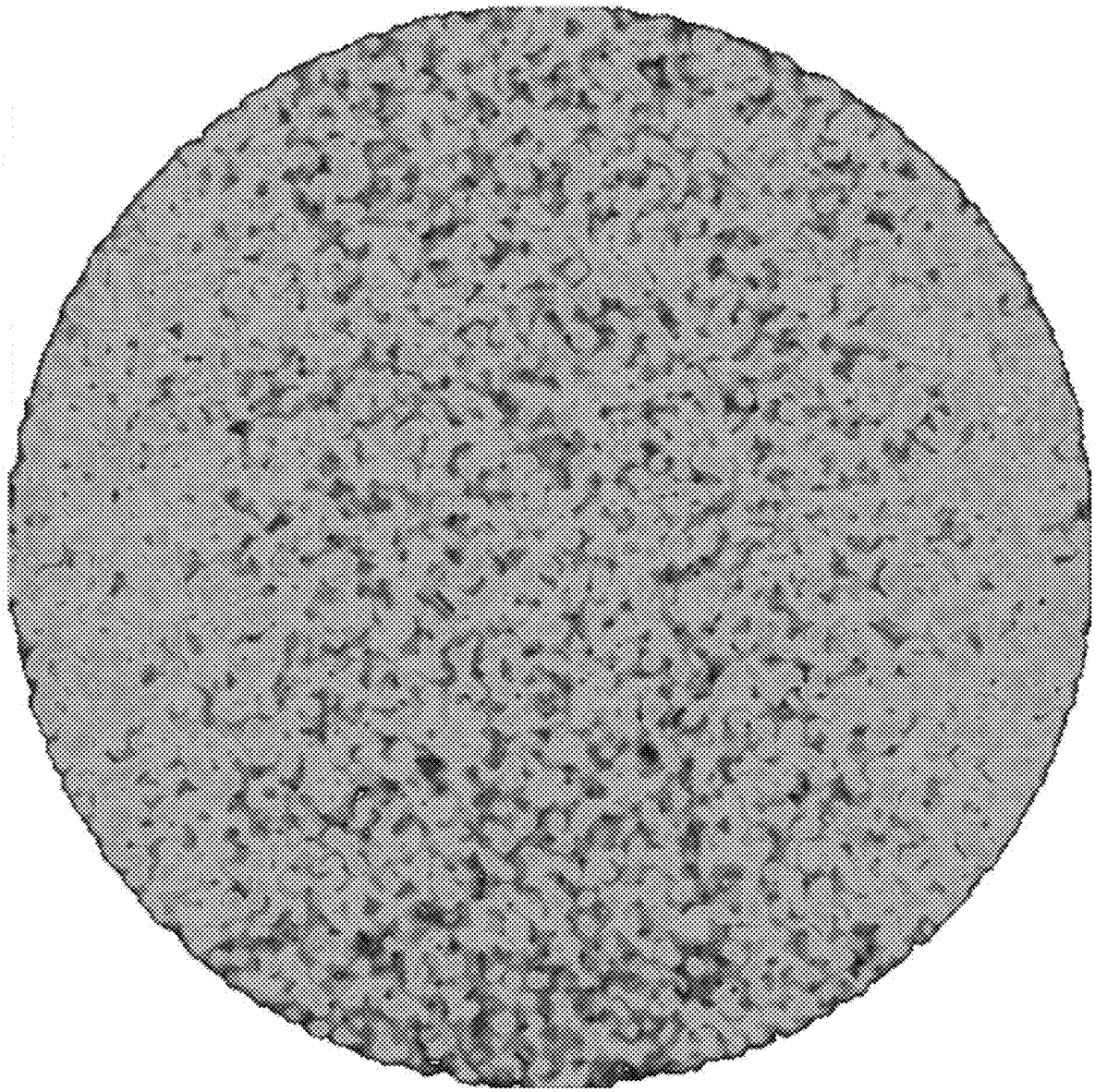


FIG. 10

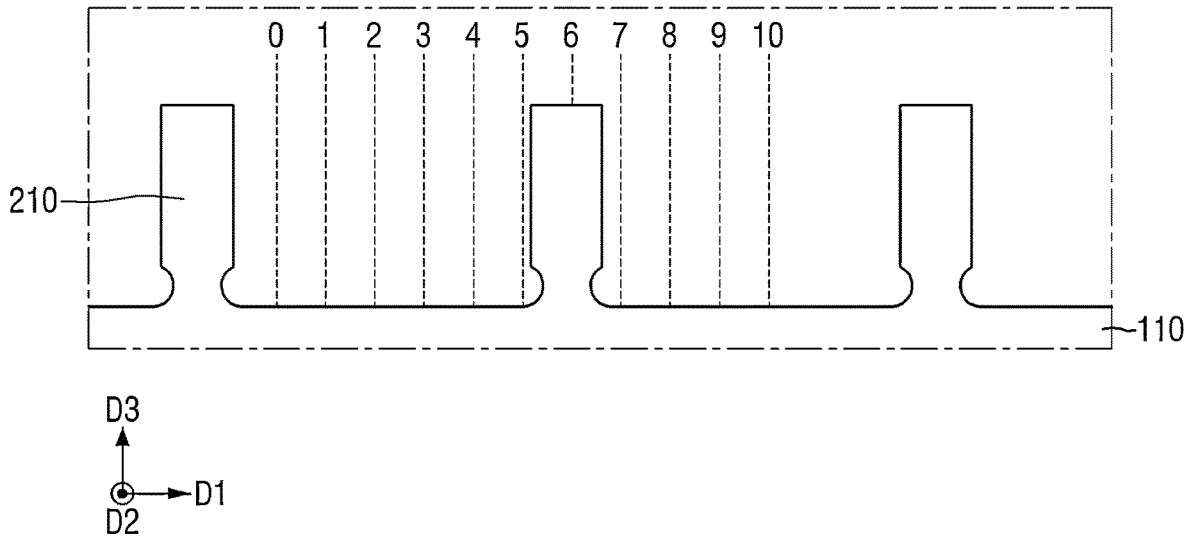

0
1
2
3
4
5
6
7
8
9
10
210
110
D3
D1
D2

FIG. 11

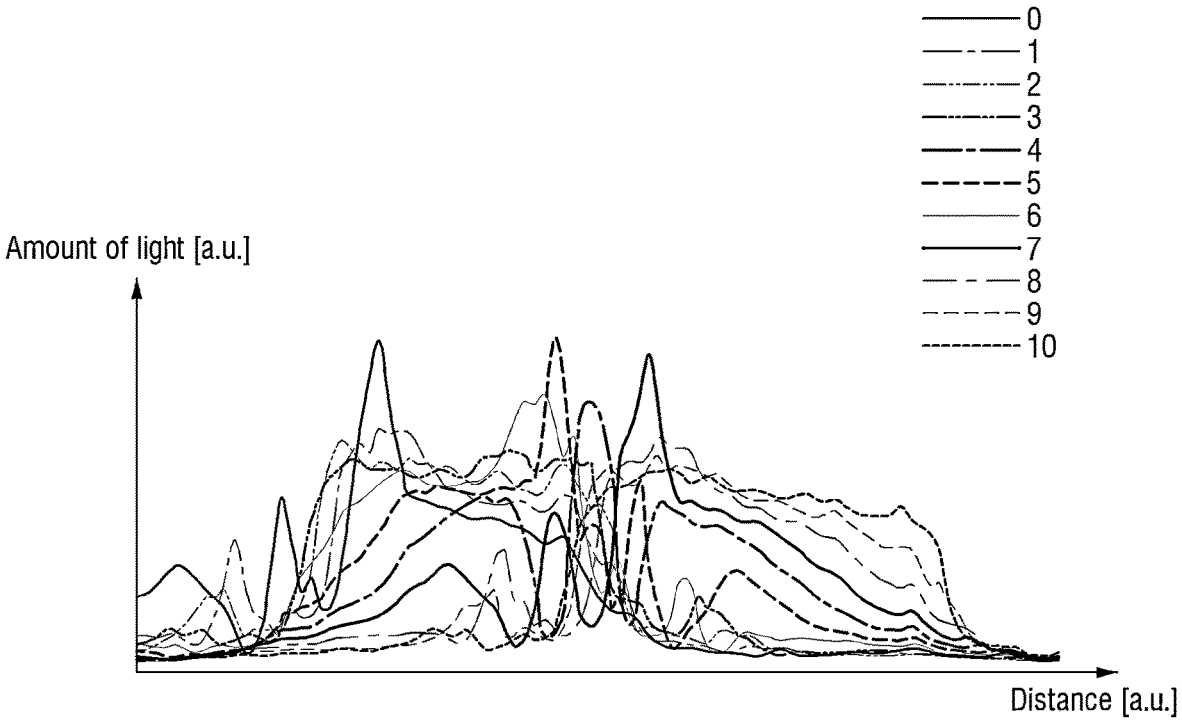

0
1
2
3
4
5
6
7
8
9
10
Amount of light [a.u.]
Distance [a.u.]

FIG. 12

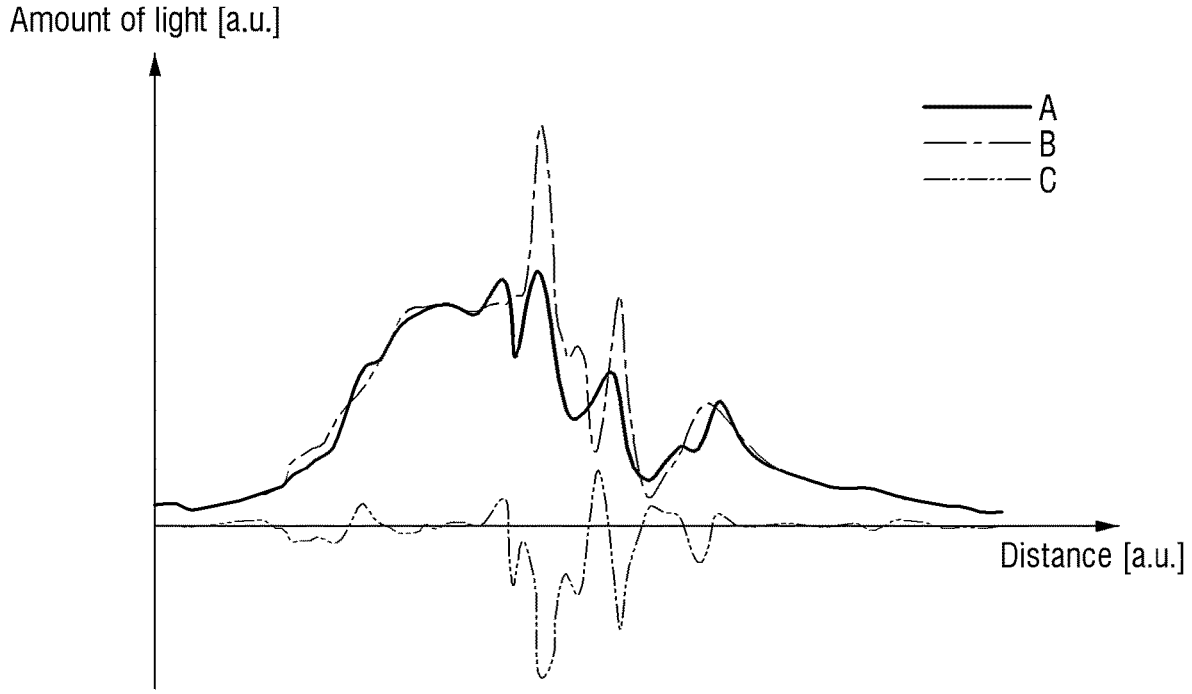

Amount of light [a.u.]
A
B
C
Distance [a.u.]

FIG. 13

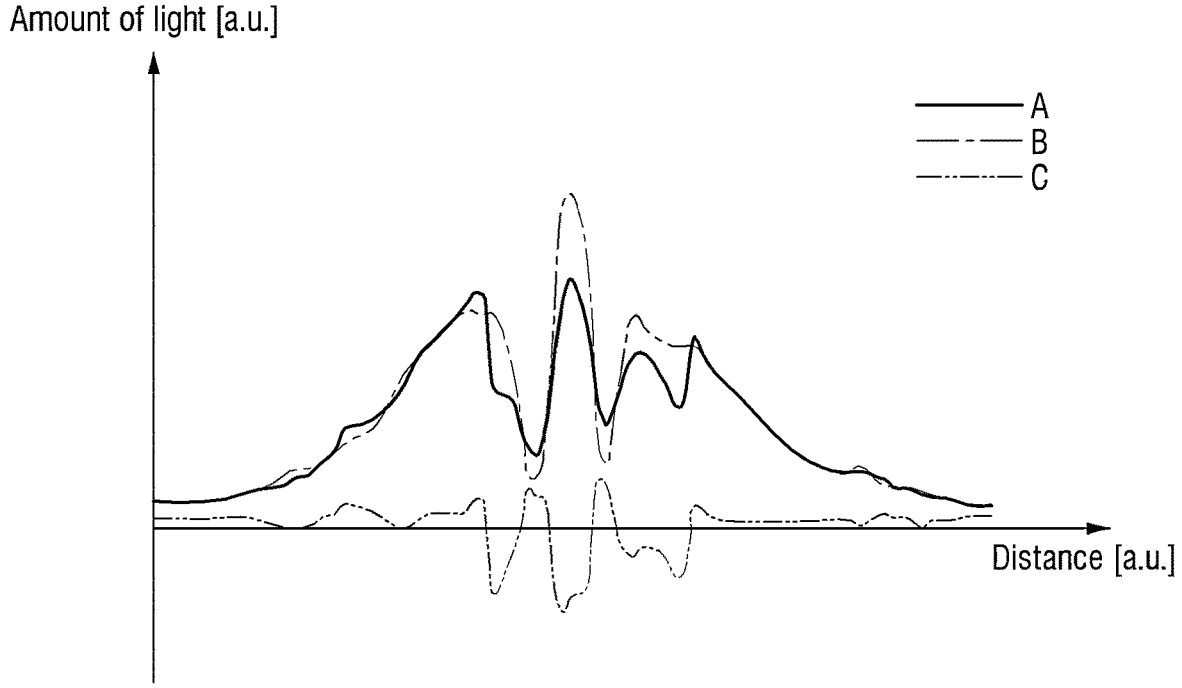

Amount of light [a.u.]
A
B
C
Distance [a.u.]

FIG. 14

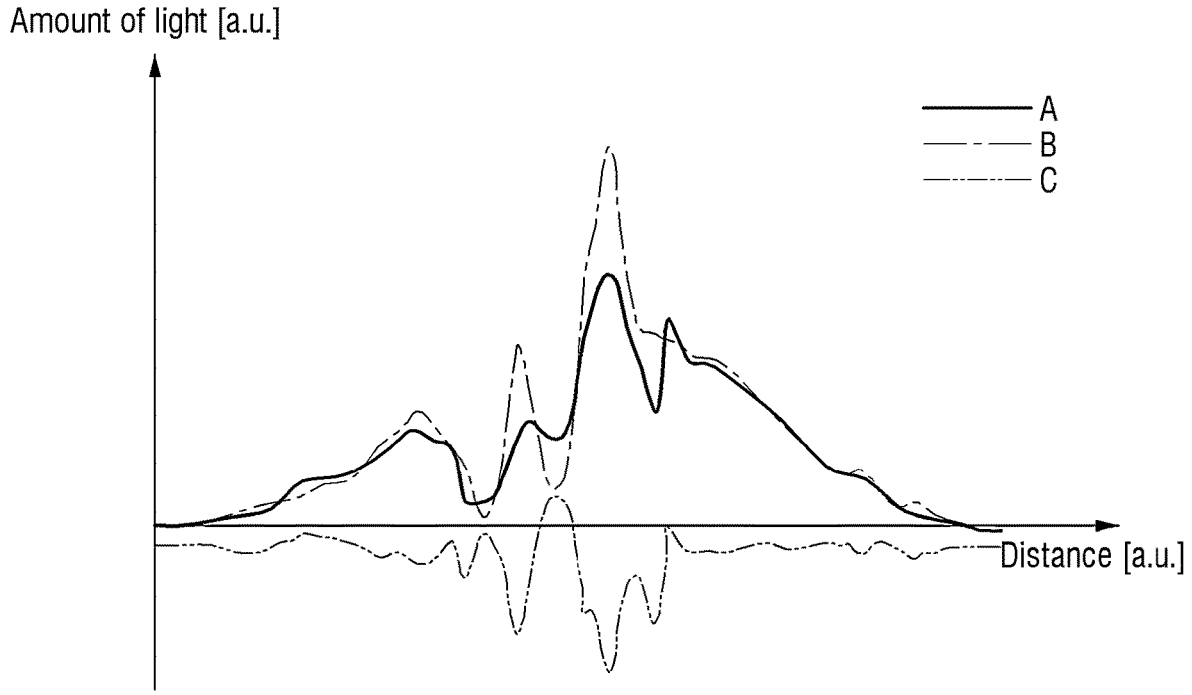

Amount of light [a.u.]
A
B
C
Distance [a.u.]

FIG. 15

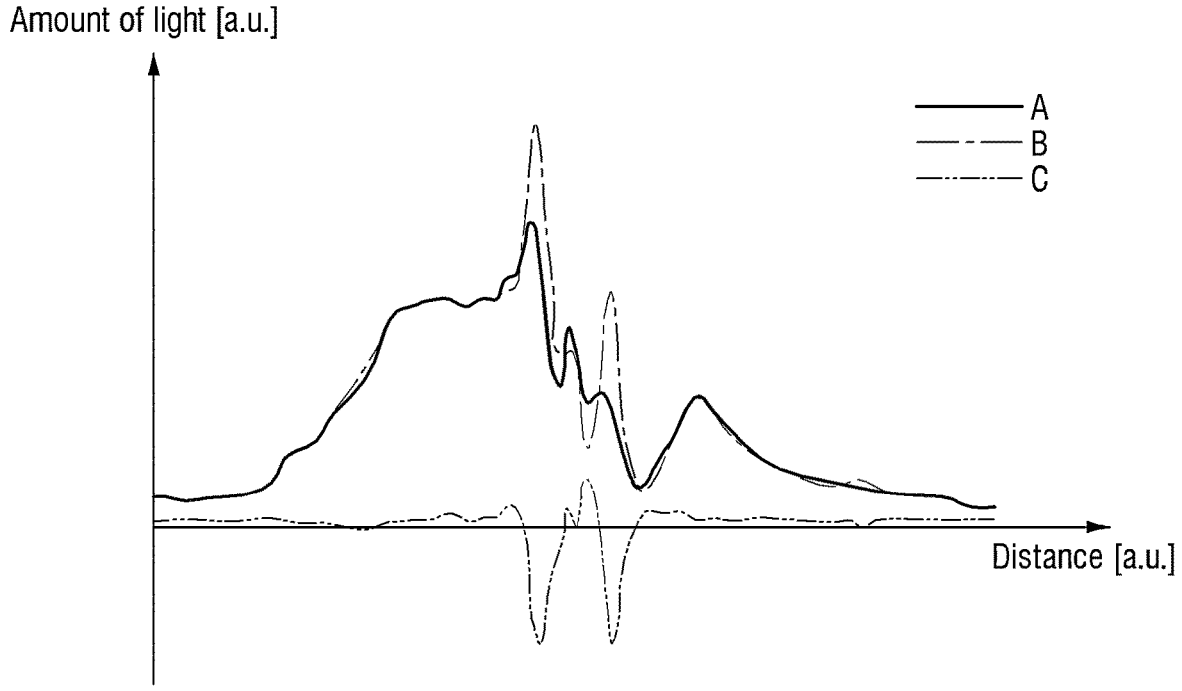

Amount of light [a.u.]
A
B
C
Distance [a.u.]

FIG. 16

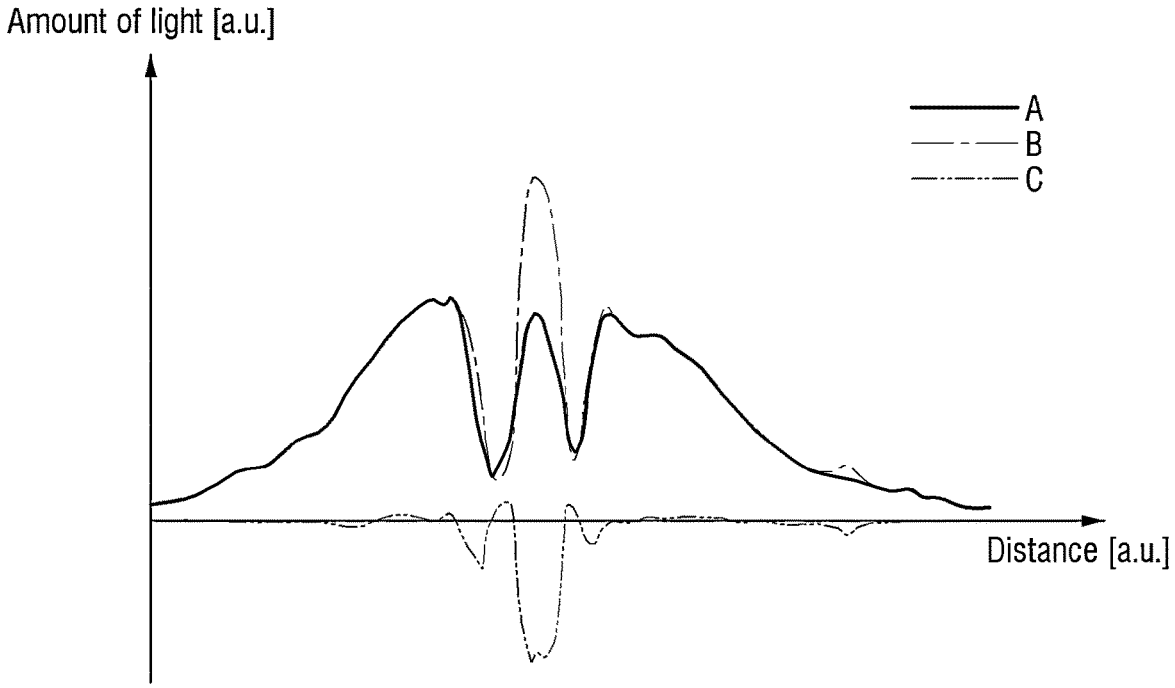

Amount of light [a.u.]
A
B
C
Distance [a.u.]

FIG. 17

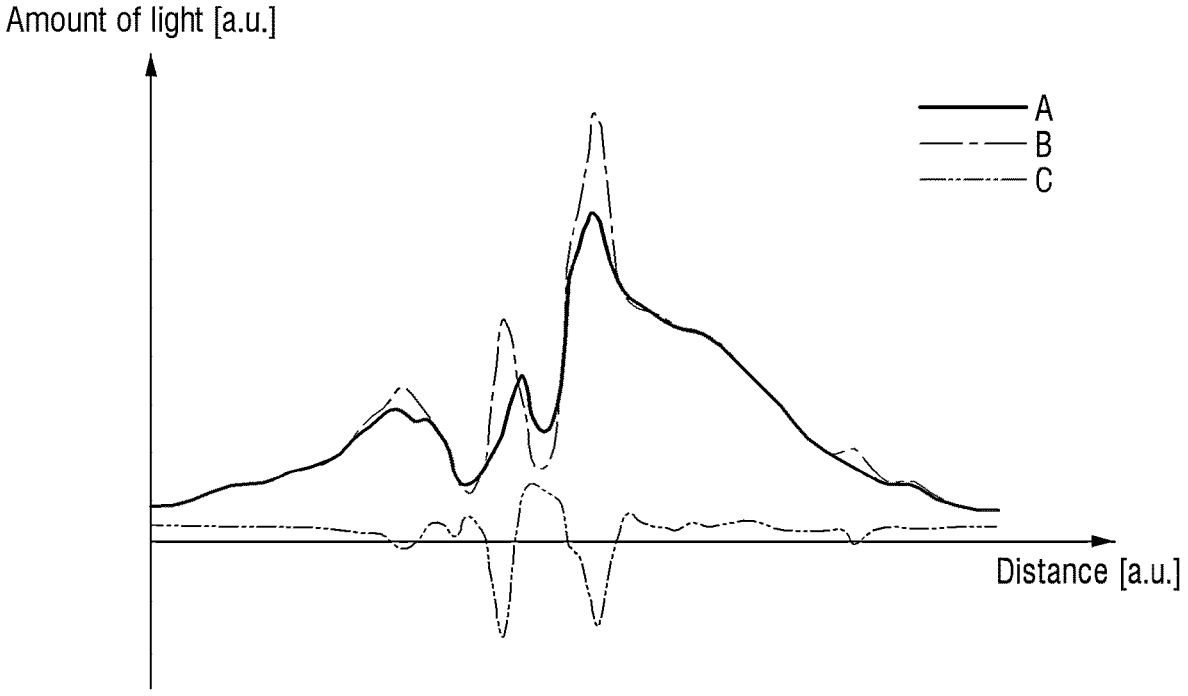

Amount of light [a.u.]
A
B
C
Distance [a.u.]

FIG. 18

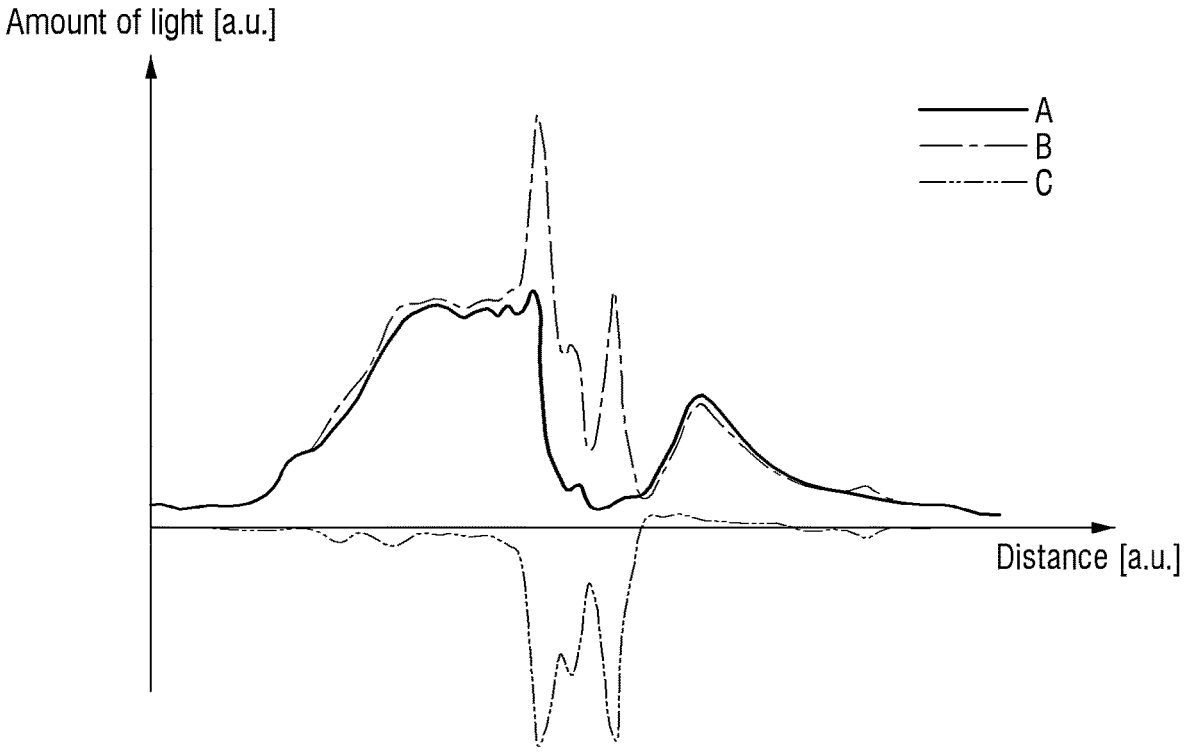


FIG. 19

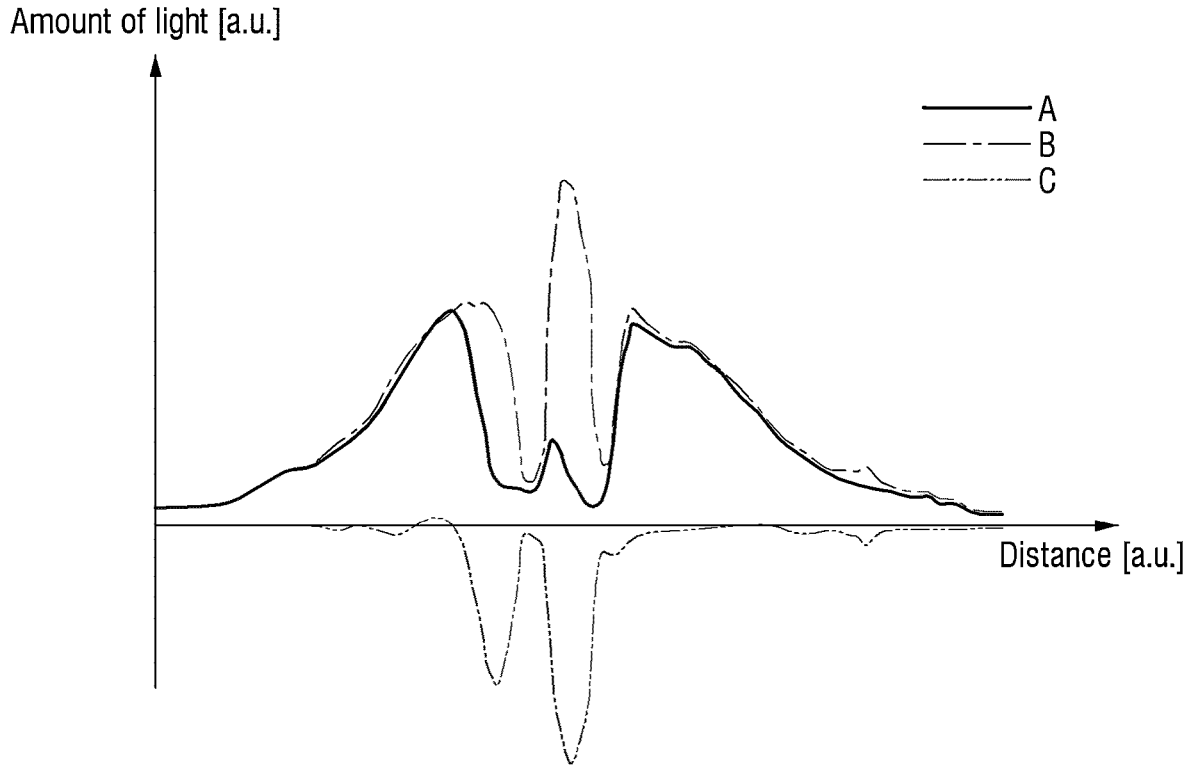

Amount of light [a.u.]
A
B
C
Distance [a.u.]

FIG. 20

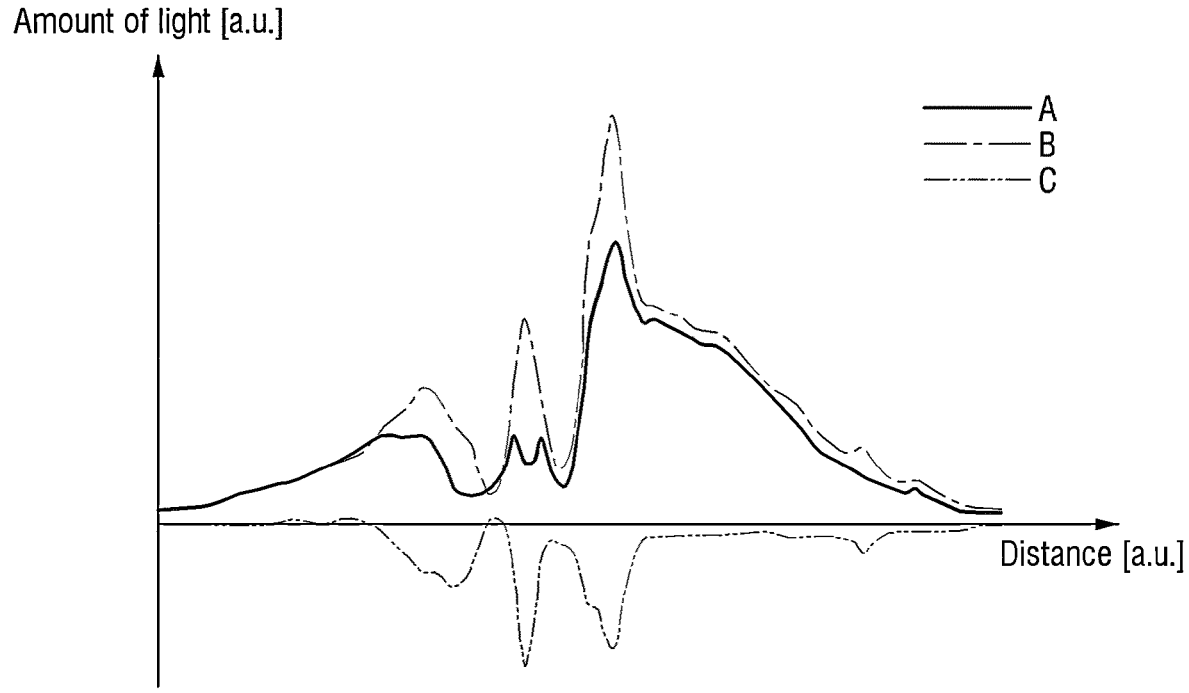

Amount of light [a.u.]
A
B
C
Distance [a.u.]

FIG. 21

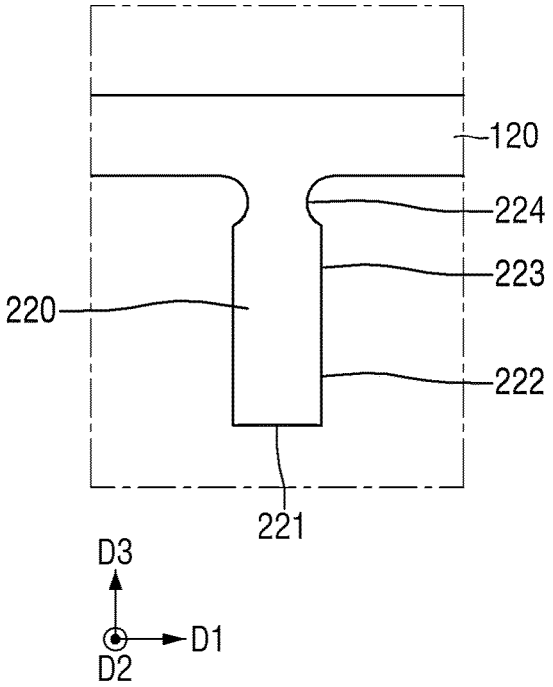

120
224
223
220
222
221
D3
D1
D2

FIG. 22

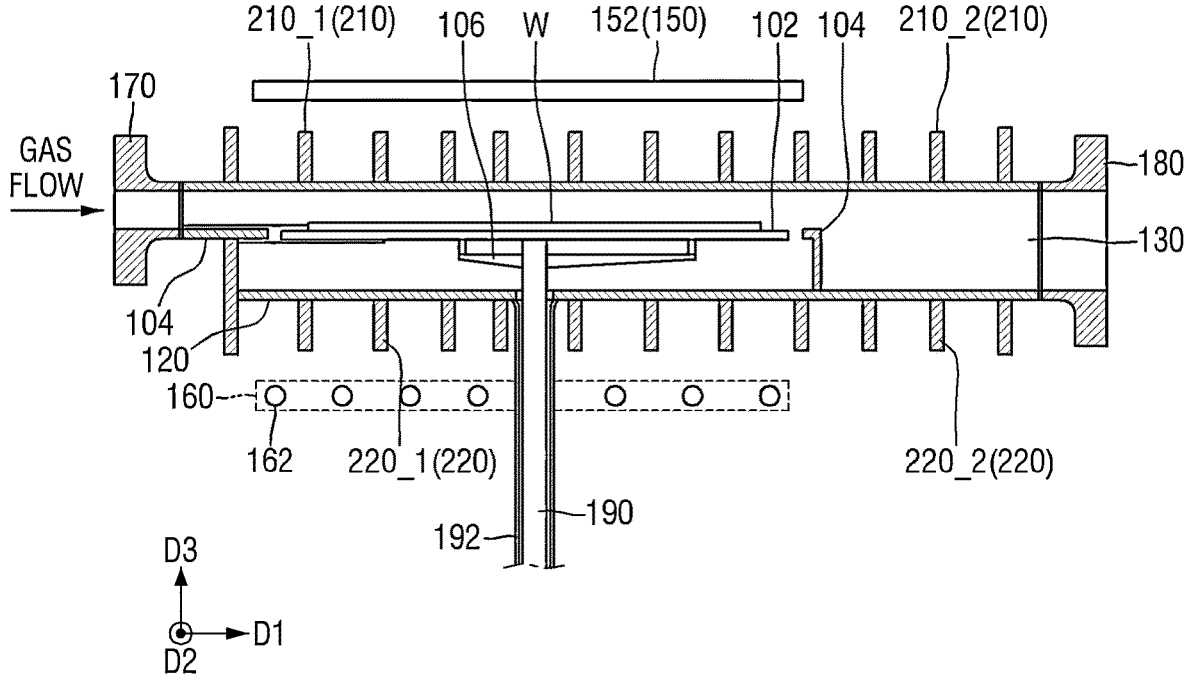

210_1(210)
106
W
152(150)
102
104
210_2(210)
170
GAS FLOW
180
130
104
120
160
162
220_1(220)
220_2(220)
190
192
D3
D1
D2

FIG. 23

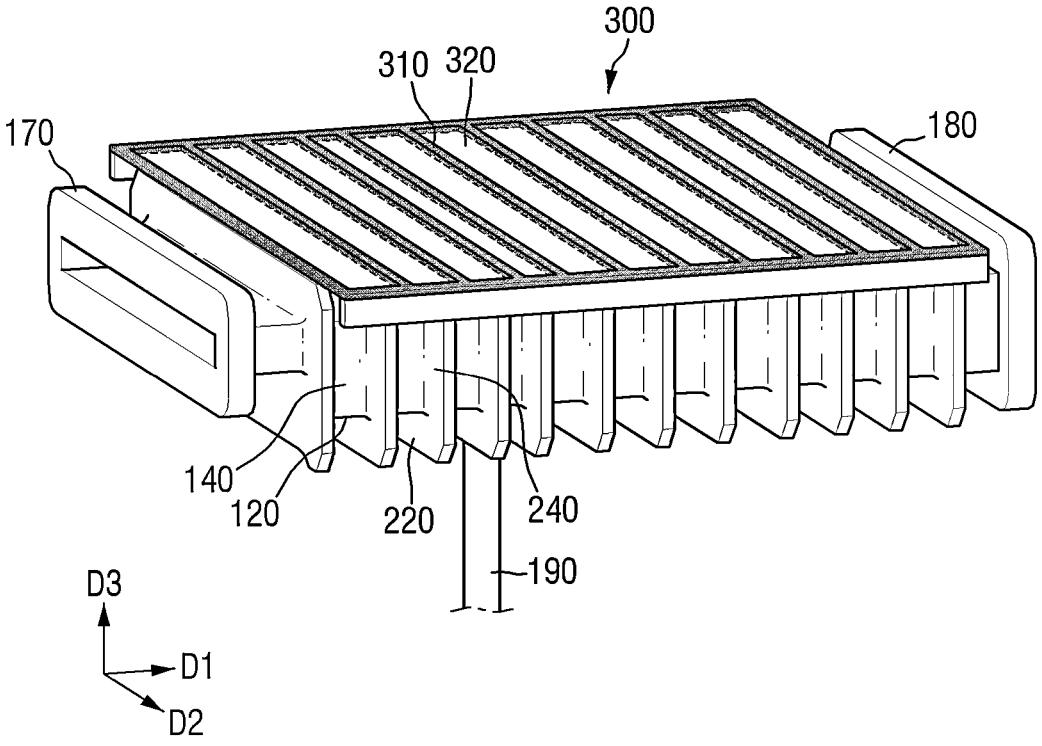


FIG. 24

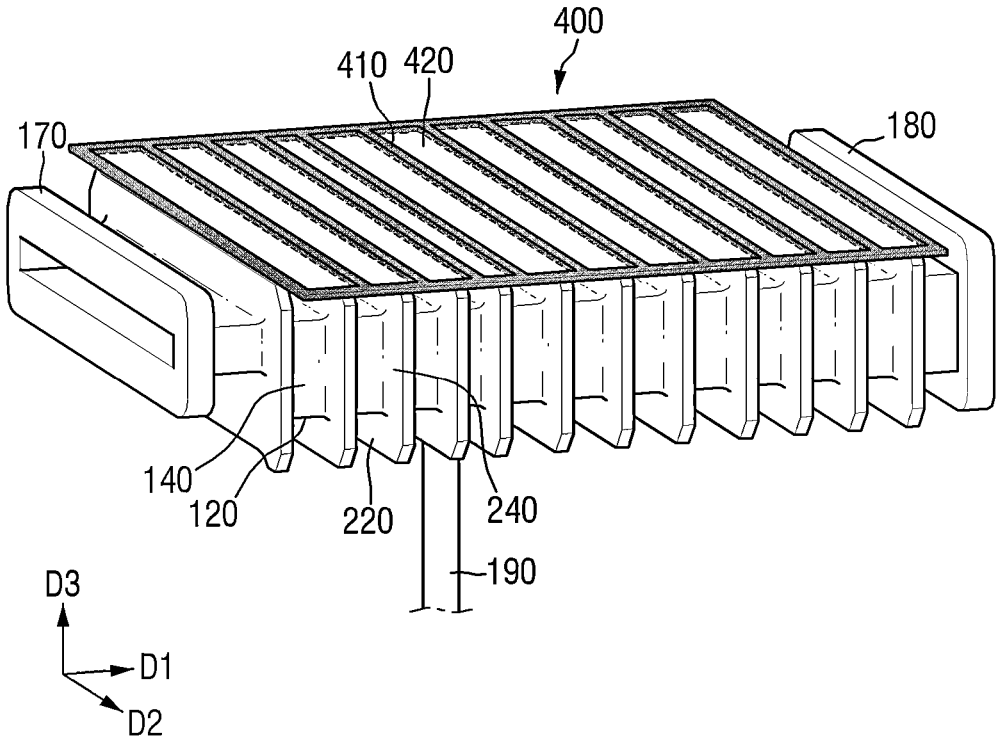

400
410
420
170
180
140
120
220
240
190
D3
D1
D2

FIG. 25

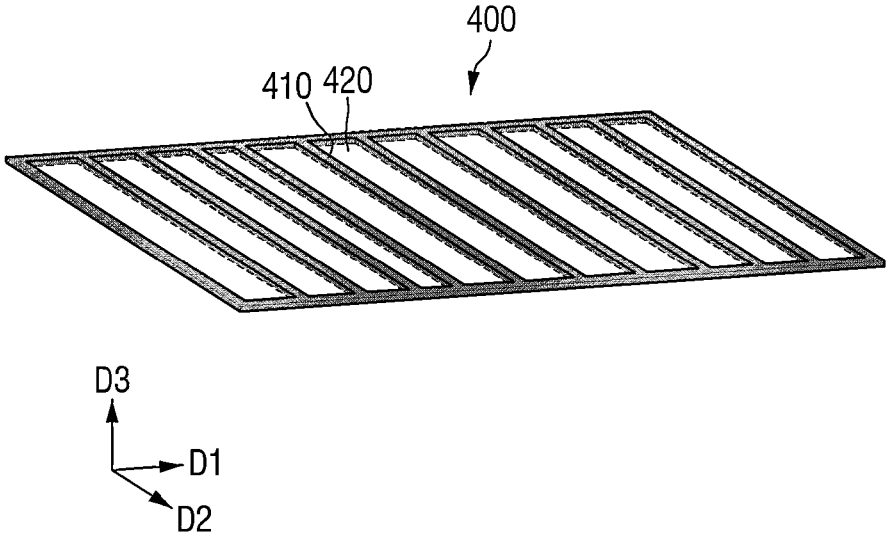

400
410
420
D3
D1
D2

FIG. 26

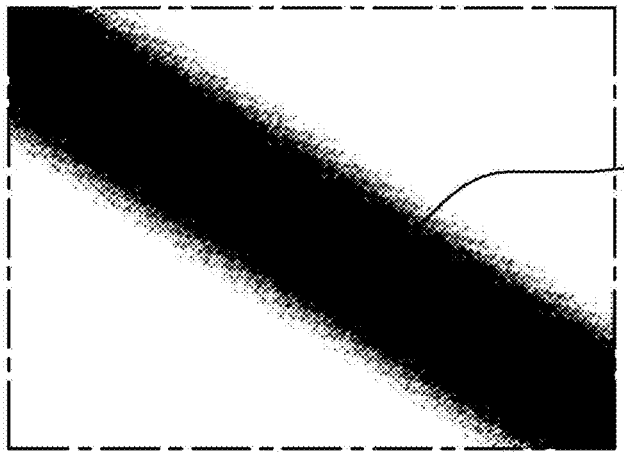


FIG. 27

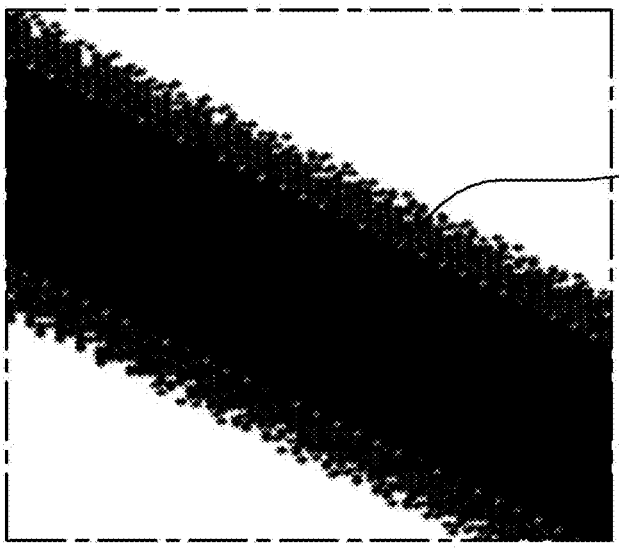
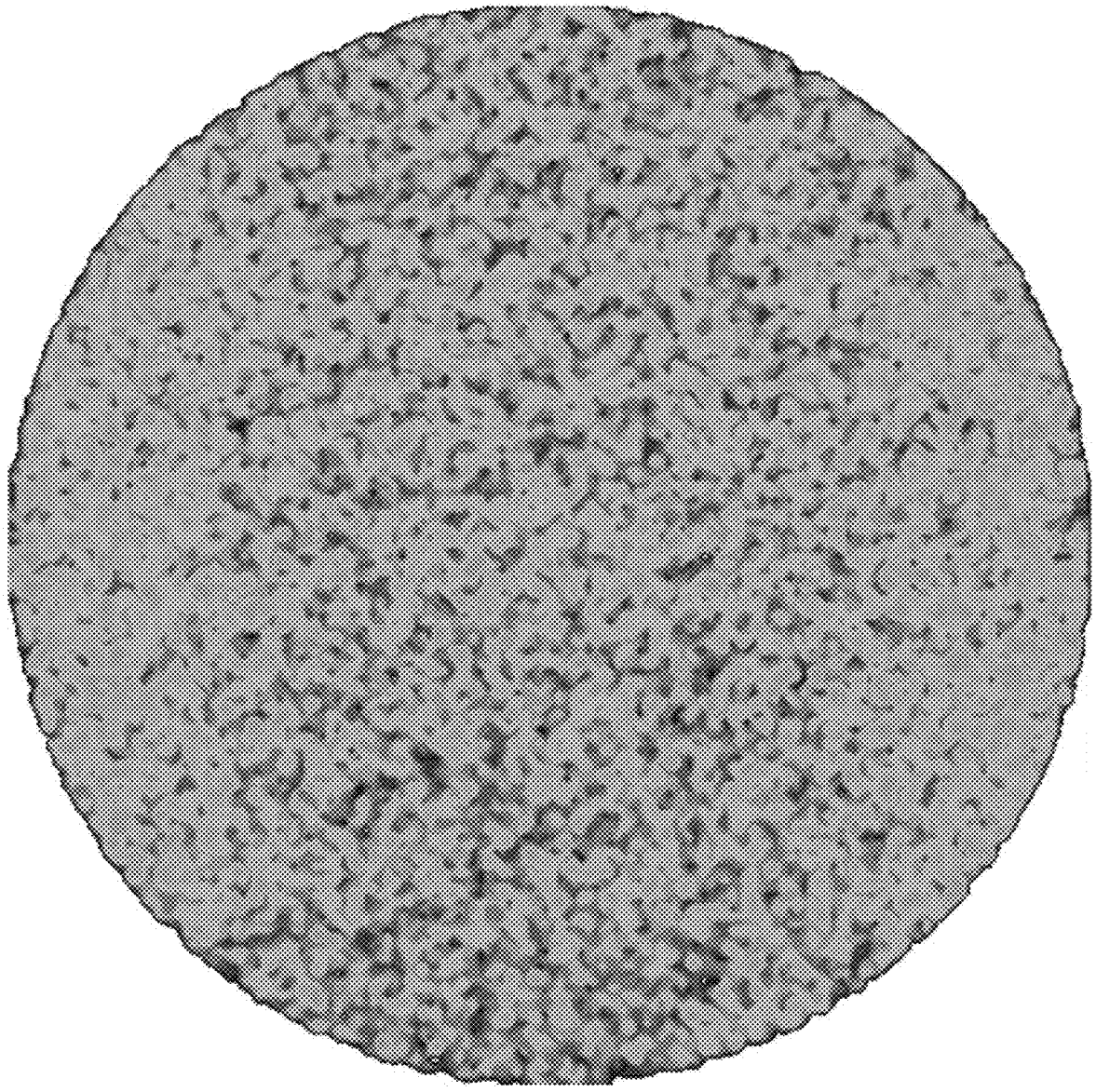


FIG. 28



WAFER PROCESSING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority from Korean Patent Application No. 10-2023-0003504, filed on Jan. 10, 2023 in the Korean Intellectual Property Office and all the benefits accruing therefrom under 35 U.S.C. 119, the entire contents of which are herein incorporated by reference.

BACKGROUND

Technical Field

[0002] The present disclosure relates to a wafer processing apparatus.

Description of the Related Art

[0003] Since quartz is substantially transparent to radiant energy, a process chamber for thermally processing a semiconductor wafer is generally made of quartz or a material similar to quartz.

[0004] When a pressure in a quartz chamber is much lower than an ambient pressure, a cylindrical or spherical chamber is often used in terms of strength. This is because a curved surface can best withstand an inward force. However, when a flat wafer is placed for the purpose of chemical vapor deposition in which a deposition gas flows in parallel with the wafer, a chamber wall may be parallel with an opposite flat surface of the wafer in order to obtain uniform deposition on a wafer surface. The uniform deposition may obtain a high yield of acceptable products that can be made from such a wafer. However, the flat wall can be collapsed inwardly as its internal pressure is reduced more quickly than a convex wall having a similar size and thickness.

[0005] A reinforcement plate or rib may be disposed on an outer wall of the chamber to process a force inwardly directed from a flat sidewall of the chamber. However, a deviation may occur in the amount of light transferred to the wafer due to the rib and a thickness of a film formed on the wafer may not be uniform.

BRIEF SUMMARY

[0006] An aspect of the present disclosure is to provide a wafer processing apparatus in which a deviation of the amount of light provided to a wafer is resolved or reduced.

[0007] Aspects of the present disclosure are not limited to those mentioned above and additional aspects of the present disclosure, which are not mentioned herein, will be clearly understood by those skilled in the art from the following description of the present disclosure.

[0008] According to an embodiment of the present disclosure, a wafer processing apparatus may include a chamber providing an internal space; and a first rib on an outer side of a first sidewall of the chamber. An outer side of the first rib may include a first portion and a second portion. A light transmittance of the first portion may be different from a light transmittance of the second portion.

[0009] According to an embodiment of the present disclosure, a wafer processing apparatus may include a chamber providing an internal space; a first rib on an outer side of a first sidewall of the chamber; a first light source on the outer side of the first sidewall of the chamber; and a plate between the first light source and the first rib. The plate may include a first region and a second region. The first region of the plate may block light provided to the first rib, and the second region may transmit the light provided to the first rib.

[0010] According to an embodiment of the present disclosure, a wafer processing apparatus may include a chamber providing an internal space; a plurality of first ribs on an outer side of a first sidewall of the chamber; a plurality of first lamps on the outer side of the first sidewall of the chamber; a plurality of second ribs on an outer side of a second sidewall of the chamber; and a plurality of second lamps on the outer side of the second sidewall of the chamber. At least one outer side of the plurality of first ribs may include a first portion and a second portion, and a light transmittance of the first portion may be different from a light transmittance of the second portion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The above and other aspects and features of the present disclosure will become more apparent by describing in detail example embodiments thereof with reference to the attached drawings, in which:

[0012] FIG. **1** is a view illustrating a wafer processing apparatus according to some embodiments;

[0013] FIG. **2** is a view illustrating a side of the wafer processing apparatus of FIG. **1**;

[0014] FIG. **3** is a view illustrating a rib of FIG. **1**;

[0015] FIG. **4** is a cross-sectional view taken along line I-I of FIG. **1**;

[0016] FIG. **5** is a view illustrating a light path when there is a first rib in a chamber;

[0017] FIG. **6** is a view illustrating the amount of light on a wafer when there is a first rib in a chamber;

[0018] FIG. **7** is a view illustrating a light path when there is no first rib in a chamber;

[0019] FIG. **8** is a view illustrating a first rib according to some embodiments;

[0020] FIG. **9** is a view illustrating the amount of light on a wafer when the first rib of FIG. **8** is formed in a chamber;

[0021] FIGS. **10** to **20** are views illustrating effects of a wafer processing apparatus according to some embodiments;

[0022] FIG. **21** is a view illustrating a second rib according to some embodiments;

[0023] FIG. **22** is a view illustrating a wafer processing apparatus according to some embodiments;

[0024] FIG. **23** is a view illustrating a wafer processing apparatus according to some embodiments;

[0025] FIG. **24** is a view illustrating a wafer processing apparatus according to some embodiments;

[0026] FIG. **25** is a view illustrating a plate of FIG. **24**;

[0027] FIGS. **26** and **27** are views illustrating a first region of the plate of FIG. **24**; and

[0028] FIG. **28** is a view illustrating the amount of light on a wafer formed in the wafer processing apparatus of FIG. **23** or **24**.

DETAILED DESCRIPTION OF THE DISCLOSURE

[0029] FIG. **1** is a view illustrating a wafer processing apparatus according to some embodiments. FIG. **2** is a view illustrating a side of the wafer processing apparatus of FIG. **1**. FIG. **3** is a view illustrating a rib of FIG. **1**. FIG. **4** is a cross-sectional view taken along line I-I of FIG. **1**.

[0030] Referring to FIGS. **1** to **4**, a wafer processing apparatus according to some embodiments may include a chamber **100**, a susceptor **102**, a plurality of first lamps **152**, a plurality of second lamps **162**, an inlet flange **170**, an outlet flange **180** and first to fourth ribs **210**, **220**, **230** and **240**.

[0031] The chamber **100** may provide an internal space S therein. The inner space may be provided as a space in which a substrate is processed. The chamber **100** may have a shape extended in a second direction D**2**. The second direction D**2** may cross a first direction D**1**.

[0032] The chamber **100** may include first to fourth sidewalls **110**, **120**, **130** and **140**. The first to fourth sidewalls **110**, **120**, **130** and **140** may be extended to be long in the second direction D**2**. The first sidewall **110** and the second sidewall **120** may be extended in the second direction D**2**, and the third sidewall **130** and the fourth sidewall **140** may be extended in a third direction D**3**. The third direction D**3** may cross the first direction D**1** and the second direction D**2**.

[0033] The first sidewall **110** and the second sidewall **120** may be connected to each other by the third sidewall **130** and the fourth sidewall **140**. Therefore, the first to fourth sidewalls **110**, **120**, **130** and **140** may define an internal space S. The internal space S may be defined by inner sides of the first to fourth sidewalls **110**, **120**, **130** and **140**.

[0034] The chamber **100** may have various shapes. The chamber **100** may be composed of (or include) quartz, for example.

[0035] The inlet flange **170** and the outlet flange **180** may be coupled to the first to fourth sidewalls **110**, **120**, **130** and **140**. A process gas may flow into the inlet flange **170**, and impurities or unreacted gas after reaction may be discharged to the outlet flange **180**.

[0036] The susceptor **102** may be disposed in the internal space S of the chamber **100**. The wafer W may be disposed on the susceptor **102**, and the susceptor **102** may support the wafer W. A rotational shaft **190** may be coupled to a lower portion of the susceptor **102**. The rotational shaft **190** may be disposed, for example, at the center of the susceptor **102**. The rotational shaft **190** may be disposed in a tube **192** extended from the second sidewall **120** of the chamber **100** in the third direction D**3**, for example. The susceptor **102** may be supported by a support **106** connected to an upper end of the rotational shaft **190**. The susceptor **102** and the wafer W may be disposed at a desired height in the chamber **100** by the rotational shaft **190**. The susceptor **102** may be substantially horizontal with an upper surface of a support plate **104**.

[0037] A first cover **150** and a second cover **160** may support the chamber **100**, and may surround the chamber **100** so that the chamber **100** may be blocked from the outside. The first cover **150** may accommodate the plurality of first lamps **152** therein to support them. The second cover **160** may accommodate the plurality of second lamps **162** therein to support them.

[0038] The plurality of first lamps **152** may be disposed on the first sidewall **110** of the chamber **100**. The plurality of first lamps **152** may be disposed to be substantially parallel with a flow of gas. The plurality of first lamps **152** may have a tube shape extended to be long in the first direction D**1**. The plurality of first lamps **152** may be arranged in the second direction D**2**.

[0039] The plurality of second lamps **162** may be disposed on the second sidewall **120** of the chamber **100**. The plurality of second lamps **162** may be disposed to be perpendicular to a flow of gas. The plurality of second lamps **162** may have a tube shape extended to be long in the second direction D**2**. The plurality of second lamps **162** may be arranged in the first direction D**1**.

[0040] The first and second lamps **152** and **162** may supply radiant heat energy used in a deposition process to the inside of the chamber **100**. For example, each of the first and second lamps **152** and **162** may be a halogen lamp. Although not shown, a plurality of lamp reflection plates may be disposed inside the first and second covers **150** and **160** in various forms to induce light from the first and second lamps **152** and **162** to be effectively supplied into the chamber **100**.

[0041] The plurality of first ribs **210** may be disposed on the first sidewall **110**. The plurality of first ribs **210** may be extended to be long in the second direction D**2** along the first sidewall **110**. The plurality of first ribs **210** may be arranged on the first sidewall **110** in the first direction D**1**, for example.

[0042] The plurality of second ribs **220** may be disposed on the second sidewall **120**. The plurality of second ribs **220** may be extended to be long in the second direction D**2** along the second sidewall **120**. The plurality of second ribs **220** may be arranged on the second sidewall **120** in the first direction D**1**, for example.

[0043] The plurality of third ribs **230** may be disposed on the third sidewall **130**. The plurality of third ribs **230** may be extended to be long in the third direction D**3** along the third sidewall **130**. The plurality of third ribs **230** may be arranged on the third sidewall **130** in the first direction D**1**, for example.

[0044] The plurality of fourth ribs **240** may be disposed on the fourth sidewall **140**. The plurality of fourth ribs **240** may be extended to be long in the third direction D**3** along the fourth sidewall **140**. The plurality of fourth ribs **240** may be arranged on the fourth sidewall **140** in the first direction D**1**, for example. The first rib **210** and the second rib **220** may be connected by the third rib **230** and the fourth rib **240**. That is, the first to fourth ribs **210**, **220**, **230** and **240** may completely surround an outer side of the chamber **100**.

[0045] In some embodiments, the third rib **230** and the fourth rib **240** may be omitted. The first rib **210** and the second rib **220** may be disposed independently of each other. A cross-section of the first rib **210** and the second rib **220** may have various shapes such as a rectangle and a circle.

[0046] FIG. **5** is a view illustrating a light path when there is a first rib in a chamber. FIG. **6** is a view illustrating the amount of light on a wafer when there is a first rib in a chamber. FIG. **7** is a view illustrating a light path when there is no first rib in a chamber. In FIG. **6**, the darker color represents the greater amount of light.

[0047] Referring to FIGS. **5** and **7**, light provided from the first lamp **152** may be provided onto the wafer W by passing through the first rib **210**, the first sidewall **110** and the internal space S of the chamber **100**. That is, a light path deviation may occur due to refraction, reflection, etc. by the first rib **210**. Therefore, when there is the first rib **210**, a deviation in the amount of light may occur on the wafer W. Referring to FIG. **6**, a relatively large portion of the amount of light concentrated by being guided by the first rib **210** may be generated in a line pattern shape. A deviation may occur in a thickness of a film formed on the wafer W due to the deviation in the amount of light.

[0048] FIG. **8** is a view illustrating a first rib according to some embodiments. FIG. **9** is a view illustrating the amount of light on a wafer when the first rib of FIG. **8** is formed in a chamber. In FIG. **9**, the darker color represents the greater amount of light.

[0049] Referring to FIG. **8**, an outer side of the first rib **210** may include an upper surface **211** and sides **212**, **213** and **214**. The upper surface **211** may be based on the third direction D**3**. The first side **212** may be a side connected to the upper surface **211**, the third side **214** may be a side connected to the first sidewall **110**, and the second side **213** may be a side connected to the first side **212** and the third side **214**. The third side **214** may be concave. The first side **212** may correspond to a first portion of a sidewall of the first rib **210** for an upper region of the first rib **210**. The second side **213** may correspond to a second portion of the sidewall of the first rib **210** for an intermediate region of the first rib **210**. The third side **214** may correspond to a third portion of the sidewall of the first rib **210** for a lower region of the first rib **210**. The intermediate region of the first rib **210** may be between the upper region of the first rib **210** and the lower region of the first rib **210** in the third direction D**3**.

[0050] The outer side of the first rib **210** according to some embodiments may include a first portion and a second portion, which are different from each other in light transmittance. In some embodiments, the first portion may be at least a portion of the outer side of the first rib **210**, and the second portion may be the other portion except the first portion of the outer side of the first rib **210**.

[0051] The light transmittance of the first portion may be smaller than that of the second portion. The first portion may be referred to as a diffuser surface. For example, the light transmittance of the first portion may be smaller than that of the second portion but may not be zero. For another example, the light transmittance of the first portion may be 0, and the first portion may be an opaque surface through which light is not transmitted.

[0052] For example, the first portion may be the upper surface **211** and the first side **212** of the first rib **210**, and the second portion may be the second side **213** and the third side **214** of the first rib **210**. Therefore, the amount of light provided onto the wafer W by transmitting the upper surface **211** and the first side **212** of the first rib **210** may be reduced. Referring to FIGS. **6** and **9**, when the diffuser surface is formed in the first rib **210**, a portion (e.g., the line pattern shape portion in FIG. **6**) on which light is relatively concentrated may be reduced. Therefore, the deviation in the thickness of the film formed on the wafer W due to the deviation in the amount of light may be resolved or reduced.

[0053] In some other embodiments, the entire outer side of the first rib **210** may be a diffuser surface. The upper surface **211** and the first to third sides **212**, **213** and **214** of the first rib **210** may be diffuser surfaces.

[0054] The diffuser surface according to some embodiments may be formed by various surface processing methods such as a sand blasting method, a chemical etching method, a method using a laser and the like. For example, the diffuser surface may be formed by sand blasting at least a portion of the outer side of the first rib **210**. Therefore, a surface roughness of the first portion may be greater than that of the second portion. For example, the first portion may have a surface roughness of Ra 0.5 μm to 5 μm, for example.

[0055] The diffuser surface according to some other embodiments may be a surface where a thin film, a hologram, a grating pattern, an opaque layer or the like is formed on at least a portion of the outer side of the first rib **210**.

[0056] Referring back to FIG. **4**, the first rib **210** may include a (1-1)th rib **210_1** overlapped with the plurality of first lamps **152** (for example, overlapped in the third direction D**3**) and a (1-2)th rib **210_2** that is not overlapped with the plurality of first lamps **152**.

[0057] In some embodiments, the (1-1)th rib **210_1** and the (1-2)th rib **210_2** may include a diffuser surface.

[0058] In some other embodiments, the (1-1)th rib **210_1** includes a diffuser surface, but the (1-2)th rib **210_2** may not include a diffuser surface. The diffuser surface is formed on at least a portion of an outer side of the (1-1)th rib **210_1** but is not formed on an outer side of the (1-2)th rib **210_2**, and the outer side of the (1-2)th rib **210_2** may have a uniform light transmittance.

[0059] FIGS. **10** to **20** are views illustrating effects of a wafer processing apparatus according to some embodiments.

[0060] FIG. **11** is a graph illustrating the amount of light according to a distance from a position of 0 in FIG. **10** when one first lamp (**152** in FIG. **4**) is disposed at each of positions from 0 to 10 in FIG. **10**. Referring to FIGS. **10** and **11**, when the first lamp **152** is positioned at positions of 0, 5, 6 and 7, a deviation in the amount of light is relatively large.

[0061] FIGS. **12** to **14** are graphs illustrating the amount of light according to a distance from a position of 0 in FIG. **10** when the first lamp **152** is at each of positions of 5, 6 and 7 in FIG. **10**. In FIGS. **12** to **14**, 'A' represents an experimental result when the upper surface **211** and the third side **214** of the first rib **210** are diffuser surfaces, 'B' represents an experimental result when there is no diffuser surface in the first rib **210**, and 'C' represents a difference between 'A' and 'B.'

[0062] FIGS. **15** to **17** are graphs illustrating the amount of light according to a distance from a position of 0 in FIG. **10** when the first lamp **152** is at each of positions of 5, 6 and 7 in FIG. **10**. In FIGS. **15** to **17**, 'A' represents an experimental result when the upper surface **211** and the first side **212** of the first rib **210** are diffuser surfaces, 'B' represents an experimental result when there is no diffuser surface in the first rib **210**, and 'C' represents a difference between 'A' and 'B.'

[0063] FIGS. **18** to **20** are graphs illustrating the amount of light according to a distance from a position of 0 in FIG. **10** when the first lamp **152** is at each of positions of 5, 6 and 7 in FIG. **10**. In FIGS. **18** to **17**, 'A' represents an experimental result when the upper surface **211** of the first rib **210** is a diffuser surface, 'B' represents an experimental result when there is no diffuser surface in the first rib **210**, and 'C' represents a difference between 'A' and 'B.' At this time, the upper surface **211** of the first rib **210** may be an opaque surface. That is, light may not be transmitted to the upper surface **211** of the first rib **210**.

[0064] Referring to FIGS. **12** to **20**, when a diffuser surface is formed on at least a portion of the outer side of the first rib **210**, a deviation in the amount of light provided onto the wafer W may be reduced. Therefore, the deviation in the thickness of the film formed on the wafer W due to the deviation in the amount of light may be resolved or reduced.

[0065] FIG. **21** is a view illustrating a second rib according to some embodiments.

[0066] Referring to FIGS. **4** and **21**, the outer side of the second rib **220** may include a lower surface **221** and sides

222, 223 and 224. The lower surface 221 may be based on the third direction D3. The fourth side 222 may be a side connected to the lower surface 221, the sixth side 224 may be a side connected to the second sidewall 120, and the fifth side 223 may be a side connected to the fourth side 222 and the sixth side 224.

[0067] In some embodiments, the outer side of the second rib 220 may not include a diffuser surface. That is, the outer side of the second rib 220 may have a uniform light transmittance.

[0068] In some other embodiments, at least a portion of the outer side of the second rib 220 may include a diffuser surface. The outer side of the second rib 220 may include a diffuser surface independently of the outer side of the first rib 210.

[0069] Meanwhile, the second rib 220 may include a (2-1)th rib 220_1 overlapped with the plurality of second lamps 162 (for example, overlapped in the third direction D3) and a (2-2)th rib 220_2 that is not overlapped with the plurality of second lamps 162.

[0070] In some embodiments, the (2-1)th rib 220_1 and the (2-2)th rib 220_2 may include a diffuser surface.

[0071] In some other embodiments, the (2-1)th rib 220_1 may include a diffuser surface, but the (2-2)th rib 220_2 may not include a diffuser surface. The diffuser surface is formed on at least a portion of the outer side of the (2-1)th rib 220_1, but the diffuser surface is not formed on the outer side of the (2-2)th rib 220_2, and the outer side of the (2-2)th rib 220_2 may have a uniform light transmittance.

[0072] FIG. 22 is a view illustrating a wafer processing apparatus according to some embodiments. For convenience of description, the following description will be based on differences from those described with reference to FIGS. 1 to 21.

[0073] Referring to FIG. 22, in some embodiments, the plurality of second lamps 162 may not overlap the second rib 220 in the third direction D3. That is, the plurality of second lamps 162 may be disposed between the second ribs 220 adjacent to each other. Referring to FIGS. 10 and 11, the deviation in the amount of light may be large in a region adjacent to the first rib 210. That is, the deviation in the amount of light may be adjusted by adjusting the arrangement of the second lamp 162 and the second rib 220. Since the second lamp 162 and the second rib 220 do not overlap each other in the third direction D3, the deviation in the amount of light due to the arrangement of the second lamp 162 and the second rib 220 may be reduced.

[0074] FIG. 23 is a view illustrating a wafer processing apparatus according to some embodiments. For convenience of description, the following description will be based on differences from those described with reference to FIGS. 1 to 21.

[0075] Referring to FIG. 23, the wafer processing apparatus according to some embodiments may further include a plate 300. The plate 300 may be disposed between the chamber 100 and the plurality of first lamps 152. The plate 300 may be disposed on the first sidewall 110 of the chamber 100. The plate 300 may be disposed on the first rib 210.

[0076] The first to fourth ribs 210, 220, 230, 240 may not include a diffuser surface.

[0077] The plate 300 may include a first region 310 and a second region 320. The first region 310 and the second region 320 may be alternately disposed. The first region 310 may overlap the first rib 210, and the second region 320 may not overlap the first rib 210. The first region 310 may be opaque, and the second region 320 may be transparent. Light provided to the chamber 100 may be blocked in the first region 310 and transmitted in the second region 320. Therefore, the deviation in the amount of light on the wafer due to the first rib 210 may be resolved or reduced by the plate 300 without a diffuser surface.

[0078] FIG. 24 is a view illustrating a wafer processing apparatus according to some embodiments. FIG. 25 is a view illustrating a plate of FIG. 24. FIGS. 26 and 27 are views illustrating a first region of the plate of FIG. 24, and FIG. 28 is a view illustrating the amount of light on a wafer formed in the wafer processing apparatus of FIG. 23 or 24. In FIG. 28, the darker color represents the greater amount of light. For convenience of description, the following description will be based on differences from those described with reference to FIGS. 1 to 21.

[0079] Referring to FIGS. 24 and 25, the wafer processing apparatus according to some embodiments may further include a plate 400. The plate 400 may be disposed between the chamber 100 and the plurality of first lamps 152. The plate 400 may be disposed on the first sidewall 110 of the chamber 100. The plate 400 may be disposed on the first rib 210.

[0080] The first to fourth ribs 210, 220, 230 and 240 may not include a diffuser surface.

[0081] The plate 400 may be composed of (or include), for example, quartz.

[0082] The plate 400 may include a first region 410 and a second region 420. The first region 410 and the second region 420 may be alternately disposed. The first region 410 may overlap the first rib 210, and the second region 420 may not overlap the first rib 210.

[0083] The first region 410 may include a pattern. Referring to FIG. 26, the first region 410 may include a gradation pattern. Referring to FIG. 27, the first region 410 may include a digit pattern.

[0084] Light provided to the chamber 100 may be blocked in the first region 410 and transmitted in the second region 420. Therefore, the deviation in the amount of light provided onto the wafer W due to the first rib 210 may be resolved or reduced by the plate 400 without a diffuser surface.

[0085] Referring to FIGS. 6 and 28, when the plate 300 is disposed on the chamber 100 as shown in FIG. 23 or when the plate 400 is disposed on the chamber 100 as shown in FIG. 24, a portion (e.g., the line pattern shape portion in FIG. 6) on which the light is relatively concentrated may be reduced. Therefore, the deviation in the thickness of the film formed on the wafer W due to the deviation in the amount of light may be resolved or reduced.

[0086] Although the embodiments of the present disclosure have been described with reference to the accompanying drawings, it will be apparent to those skilled in the art that the present disclosure can be manufactured in various forms without being limited to the above-described embodiments and can be embodied in other specific forms without departing from technical spirits and characteristics of embodiments of inventive concepts. Thus, the above embodiments are to be considered in all respects as illustrative and not restrictive.

What is claimed is:

1. A wafer processing apparatus comprising:

a chamber providing an internal space; and

a first rib on an outer side of a first sidewall of the chamber, wherein

an outer side of the first rib includes a first portion and a second portion, and

a light transmittance of the first portion is different from a light transmittance of the second portion.

2. The wafer processing apparatus of claim **1**, wherein a surface roughness of the first portion is different from a surface roughness of the second portion.

3. The wafer processing apparatus of claim **1**, wherein

the first portion is an upper surface of the first rib, and

the second portion is at least a portion of a side of the first rib.

4. The wafer processing apparatus of claim **3**, wherein light transmittance of the first portion is smaller than that of the second portion.

5. The wafer processing apparatus of claim **1**, wherein

the first portion is an upper surface of the first rib and an upper region of the outer side of the first rib,

the upper region of the outer side of the first rib is connected to the upper surface of the first rib,

the second portion is a lower region of the outer side of the first rib, and

the lower region of the outer side of the first rib is connected to the first sidewall of the chamber.

6. The wafer processing apparatus of claim **5**, wherein light transmittance of the first portion is smaller than that of the second portion.

7. The wafer processing apparatus of claim **5**, wherein at least a portion of the second portion is concave.

8. The wafer processing apparatus of claim **1**, further comprising:

a second rib spaced apart from the first rib on the outer side of the first sidewall of the chamber, wherein

an outer side of the second rib includes a third portion and a fourth portion, and

a light transmittance of the third portion is different from a light transmittance of the fourth portion.

9. The wafer processing apparatus of claim **1**, further comprising:

a second rib spaced apart from the first rib on the outer side of the first sidewall of the chamber, wherein

an outer side of the second rib includes a third portion and a fourth portion, and

a light transmittance of the third portion is equal to a light transmittance of the fourth portion.

10. The wafer processing apparatus of claim **9**, further comprising:

a lamp on the outer side of the first sidewall of the chamber, wherein

the first rib overlaps the lamp, and

the second rib does not overlap the lamp.

11. The wafer processing apparatus of claim **1**, further comprising:

a second rib on an outer side of a second sidewall of the chamber.

12. The wafer processing apparatus of claim **11**, wherein

the outer side of the second rib includes a third portion and a fourth portion, and

a light transmittance of the third portion is different from a light transmittance of the fourth portion.

13. The wafer processing apparatus of claim **12**, wherein a surface roughness of the third portion is different from a surface roughness of the fourth portion.

14. The wafer processing apparatus of claim **11**, further comprising:

a lamp on the outer side of the second sidewall, wherein

the lamp does not overlap the second rib.

15. A wafer processing apparatus comprising:

a chamber providing an internal space;

a first rib on an outer side of a first sidewall of the chamber;

a first light source on the outer side of the first sidewall of the chamber; and

a plate between the first light source and the first rib, wherein

the plate includes a first region and a second region,

the first region of the plate blocks light provided to the first rib, and

the second region transmits the light provided to the first rib.

16. The wafer processing apparatus of claim **15**, wherein the first region is on the upper surface of the first rib.

17. The wafer processing apparatus of claim **15**, wherein the first region include pattern.

18. The wafer processing apparatus of claim **15**, wherein the plate includes quartz.

19. A wafer processing apparatus comprising:

a chamber providing an internal space;

a plurality of first ribs on an outer side of a first sidewall of the chamber;

a plurality of first lamps on the outer side of the first sidewall of the chamber;

a plurality of second ribs on an outer side of a second sidewall of the chamber; and

a plurality of second lamps on the outer side of the second sidewall of the chamber, wherein

at least one outer side of the plurality of first ribs includes a first portion and a second portion, and

a light transmittance of the first portion is different from a light transmittance of the second portion.

20. The wafer processing apparatus of claim **19**, wherein a surface roughness of the first portion is different from a surface roughness of the second portion.

* * * * *