US 20250259881A1

(19) United States
(12) Patent Application Publication
(10) Pub. No.: US 2025/0259881 A1
(43) Pub. Date: Aug. 14, 2025
DEMONTE et al.

(54) **SUSCEPTOR FOR A SILICON CARBIDE SUBSTRATE**

(71) Applicant: **Applied Materials, Inc.**, Santa Clara, CA (US)

(72) Inventors: **Peter DEMONTE**, Santa Clara, CA (US); **Rajagopal MURUGESAN**, Bangalore (IN); **Wolfgang R. ADERHOLD**, Cupertino, CA (US)

(21) Appl. No.: **18/813,840**

(22) Filed: **Aug. 23, 2024**

Related U.S. Application Data

(63) Continuation of application No. 18/438,621, filed on Feb. 12, 2024.

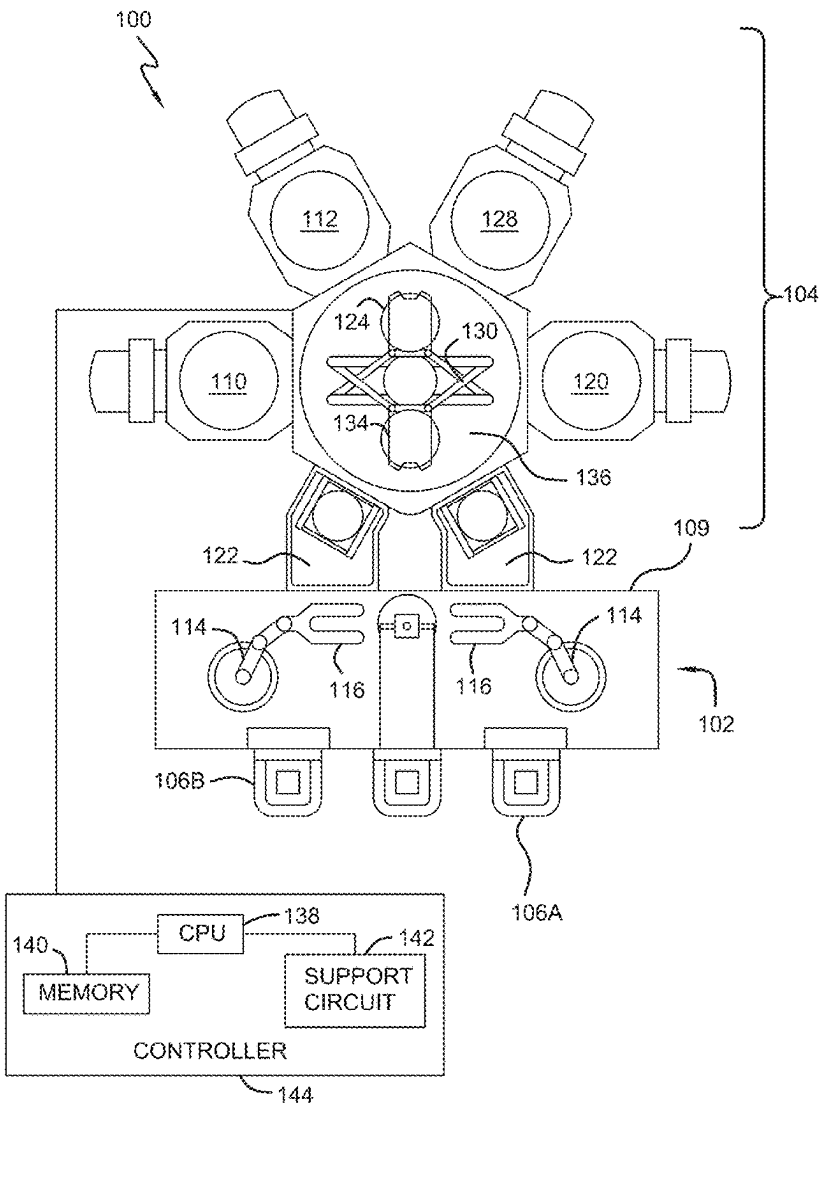
Publication Classification

(51) **Int. Cl.**
H01L 21/687 (2006.01)

(52) **U.S. Cl.**
CPC .. ***H01L 21/68785*** (2013.01); ***H01L 21/68742*** (2013.01); ***H01L 21/68757*** (2013.01)

(57) **ABSTRACT**

Disclosed herein are a detachable part of a susceptor, a susceptor including the detachable part, a substrate support assembly including the susceptor, and a processing chamber having the same. In one example, the processing chamber includes a chamber body having an interior volume, a heating module, a susceptor, and a rotatable cylinder. The heating module is arranged to direct radiation into the interior volume. The susceptor has a disk shape and is disposed in the interior volume of the chamber body to support a substrate. The susceptor is rotatable on a vertical axis and fabricated from an opaque material. The rotatable cylinder is disposed in the interior volume and has an upper circumference supporting the susceptor thereon.



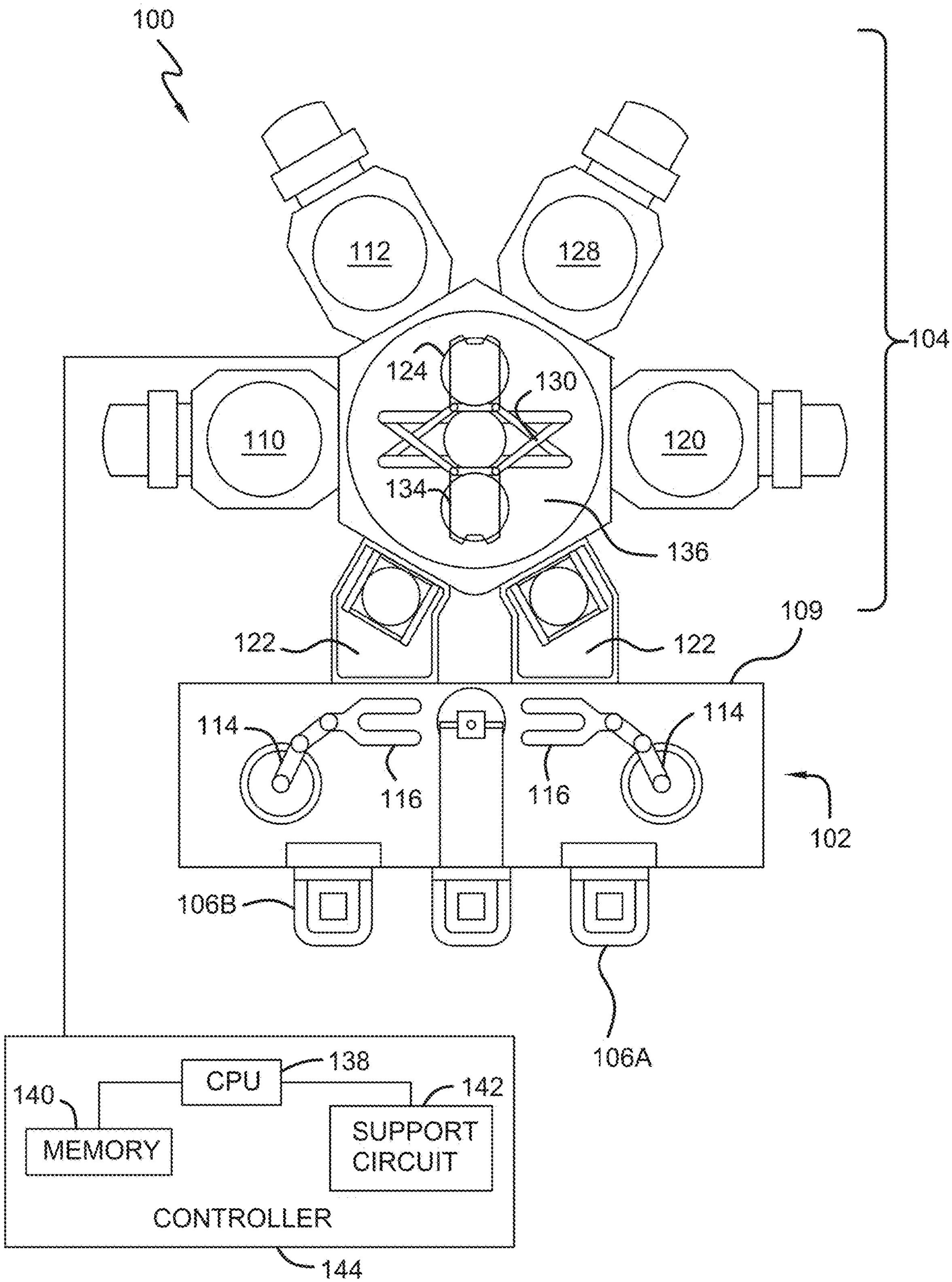

100
104
112
128
124
130
110
120
134
136
122
122
109
114
114
116
116
102
106B
106A
CPU
138
140
142
MEMORY
SUPPORT
CIRCUIT
CONTROLLER
144

FIG. 1

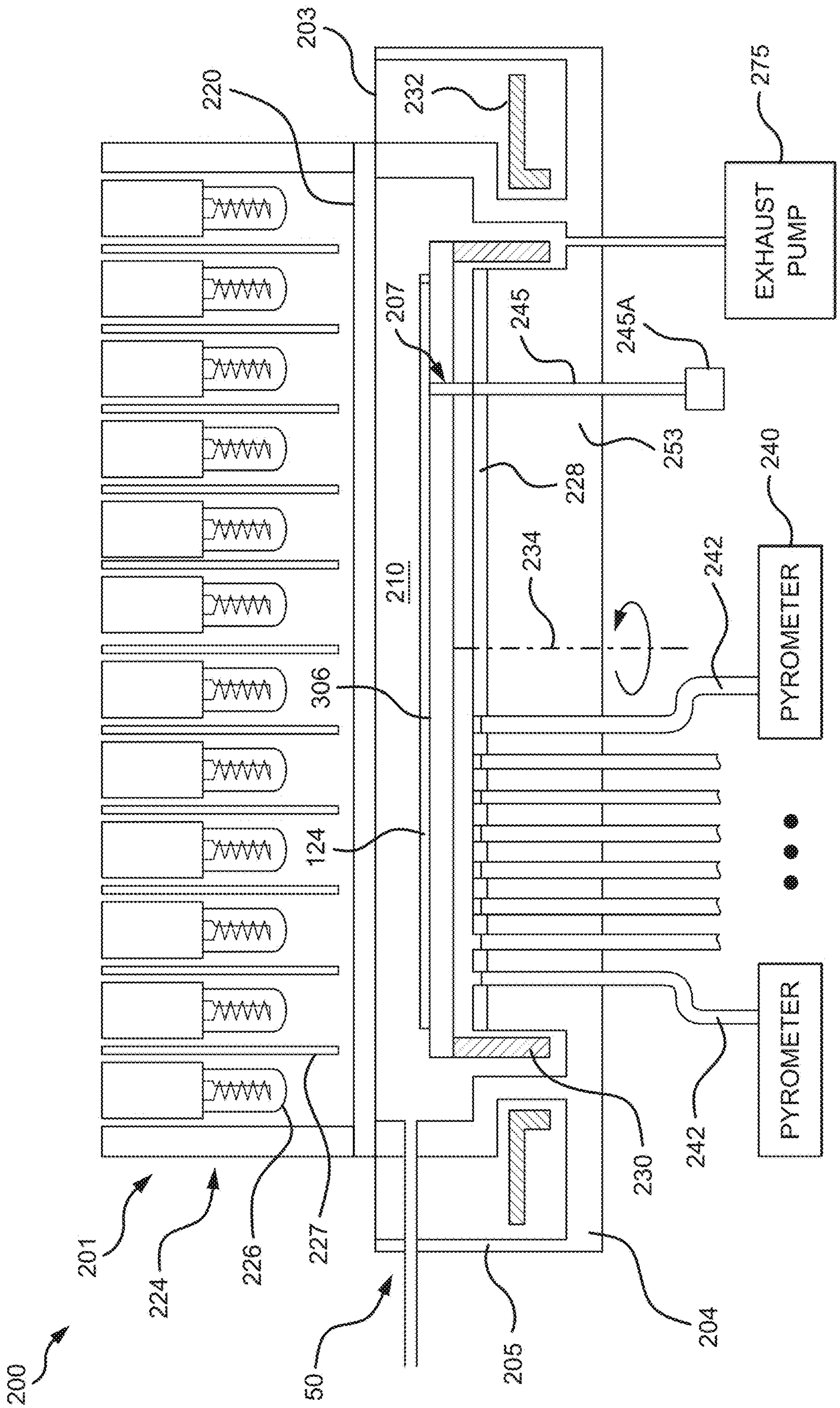

200
201
224
226
227
50
205
204
230
242
242
PYROMETER
PYROMETER
240
124
306
210
234
228
253
207
245
245A
EXHAUST PUMP
275
220
203
232

FIG. 2

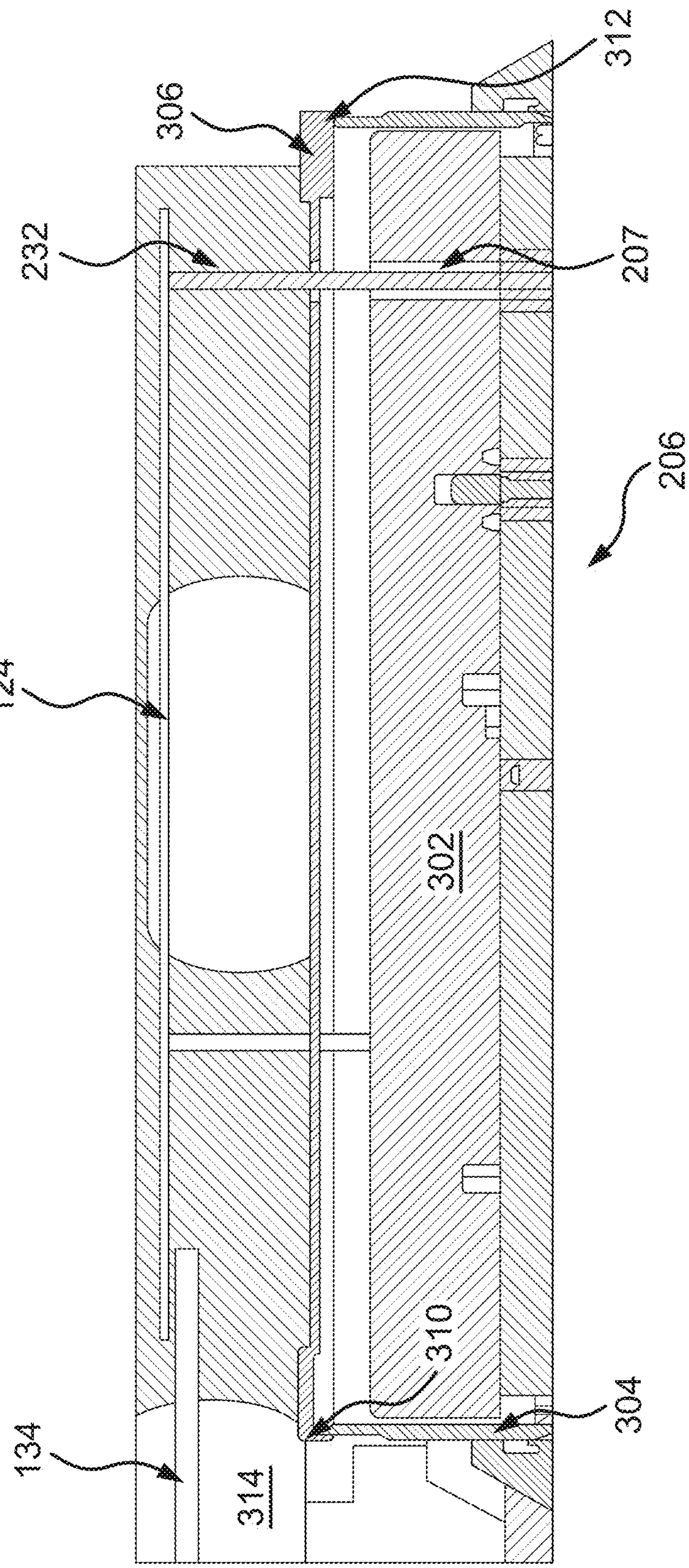


FIG. 3

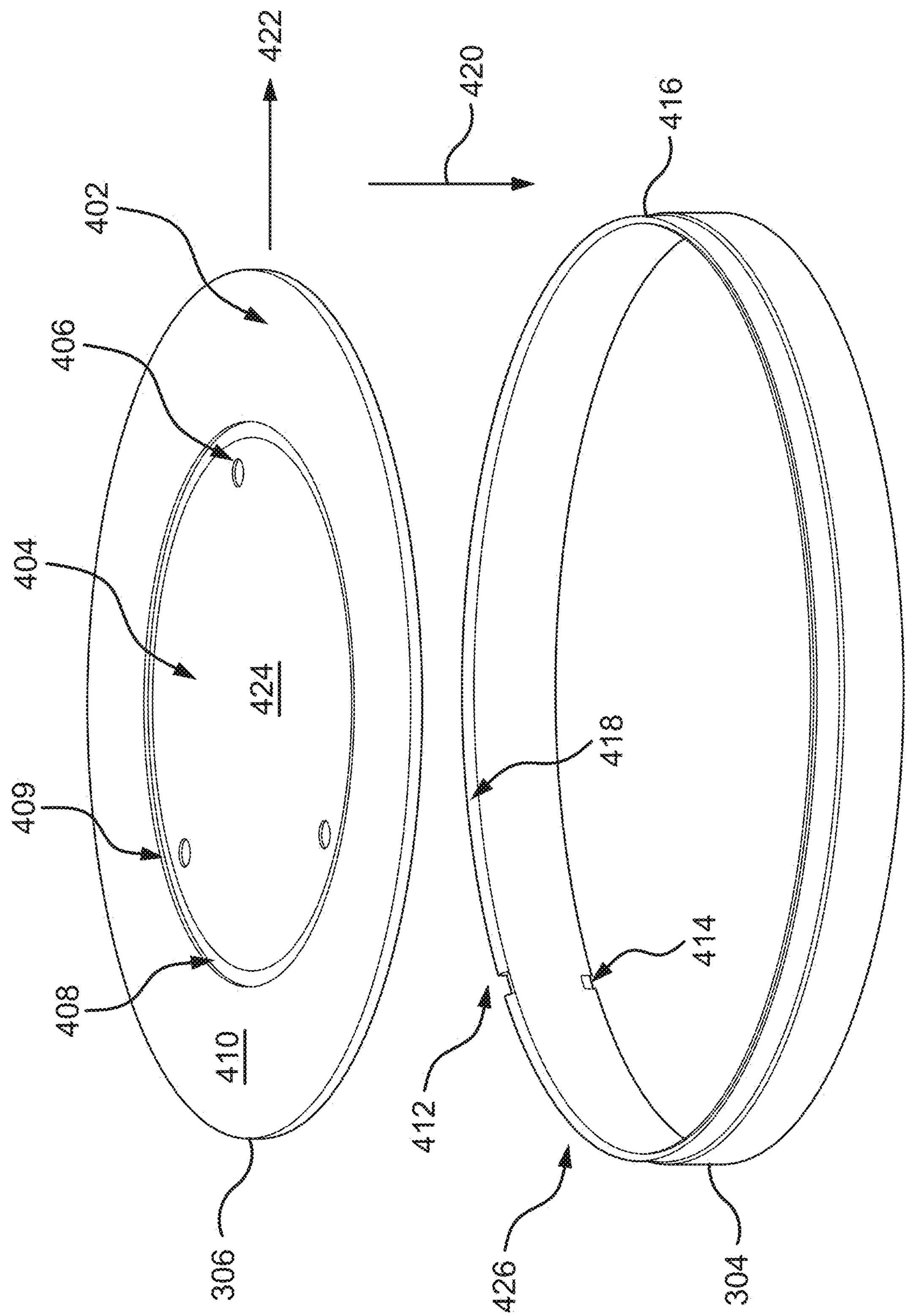


FIG. 4

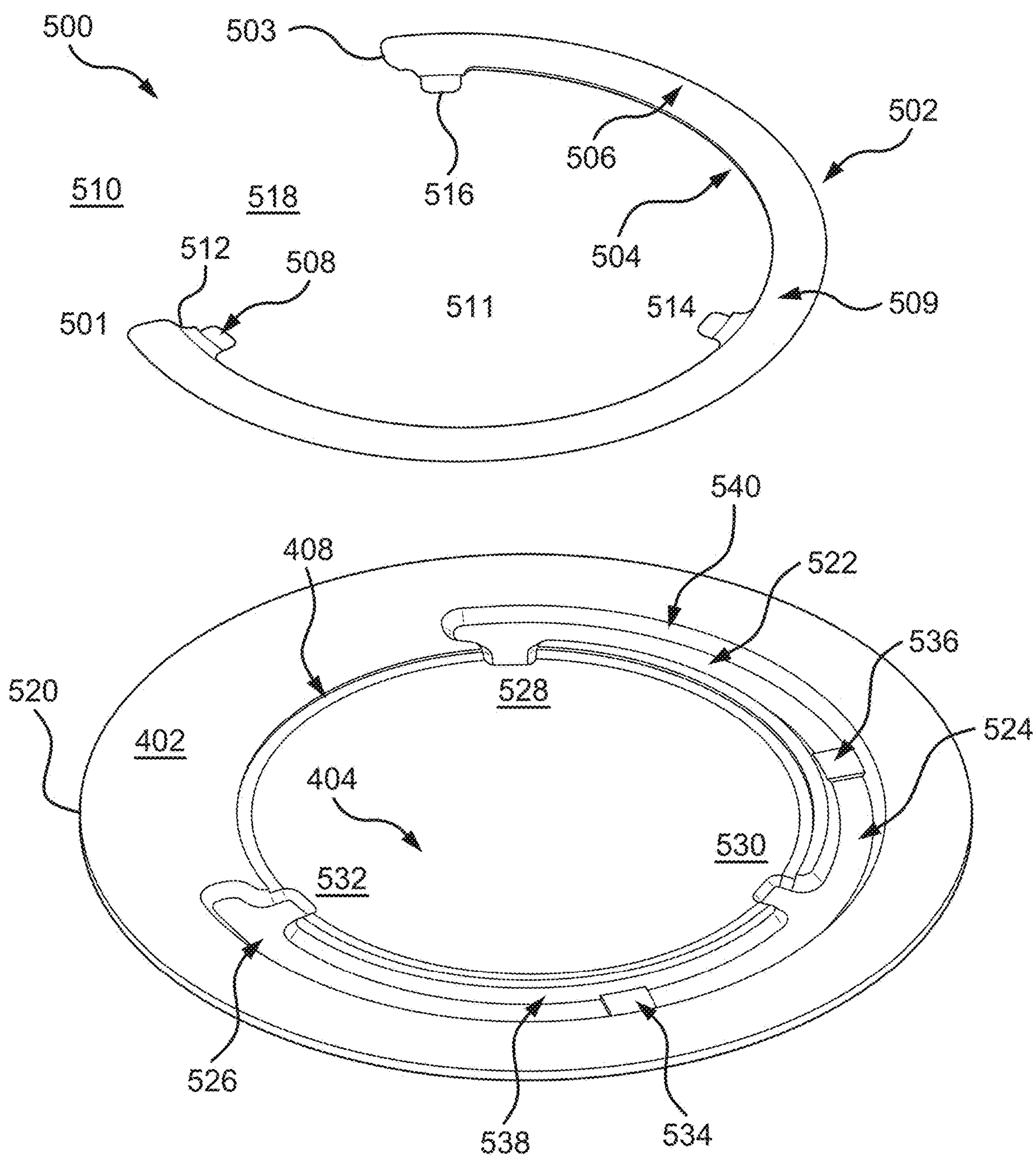

500
503
502
506
516
510
518
504
512
508
511
514
509
501
540
408
522
536
520
402
528
524
404
530
532
526
538
534

FIG. 5

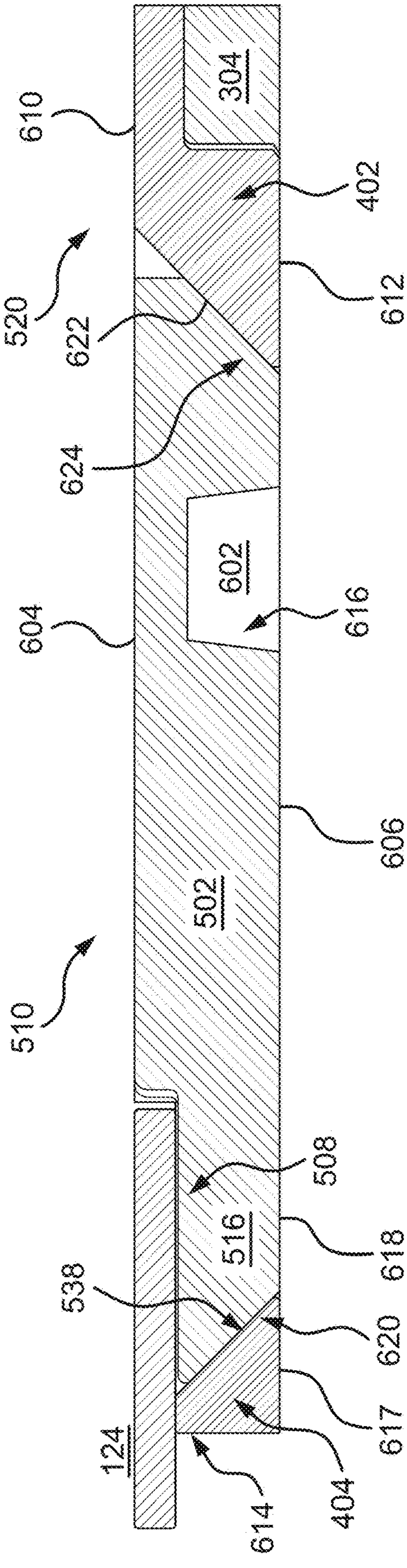

304
610
402
520
612
622
624
602
604
616
606
502
510
508
516
618
538
620
617
124
614
404

FIG. 6

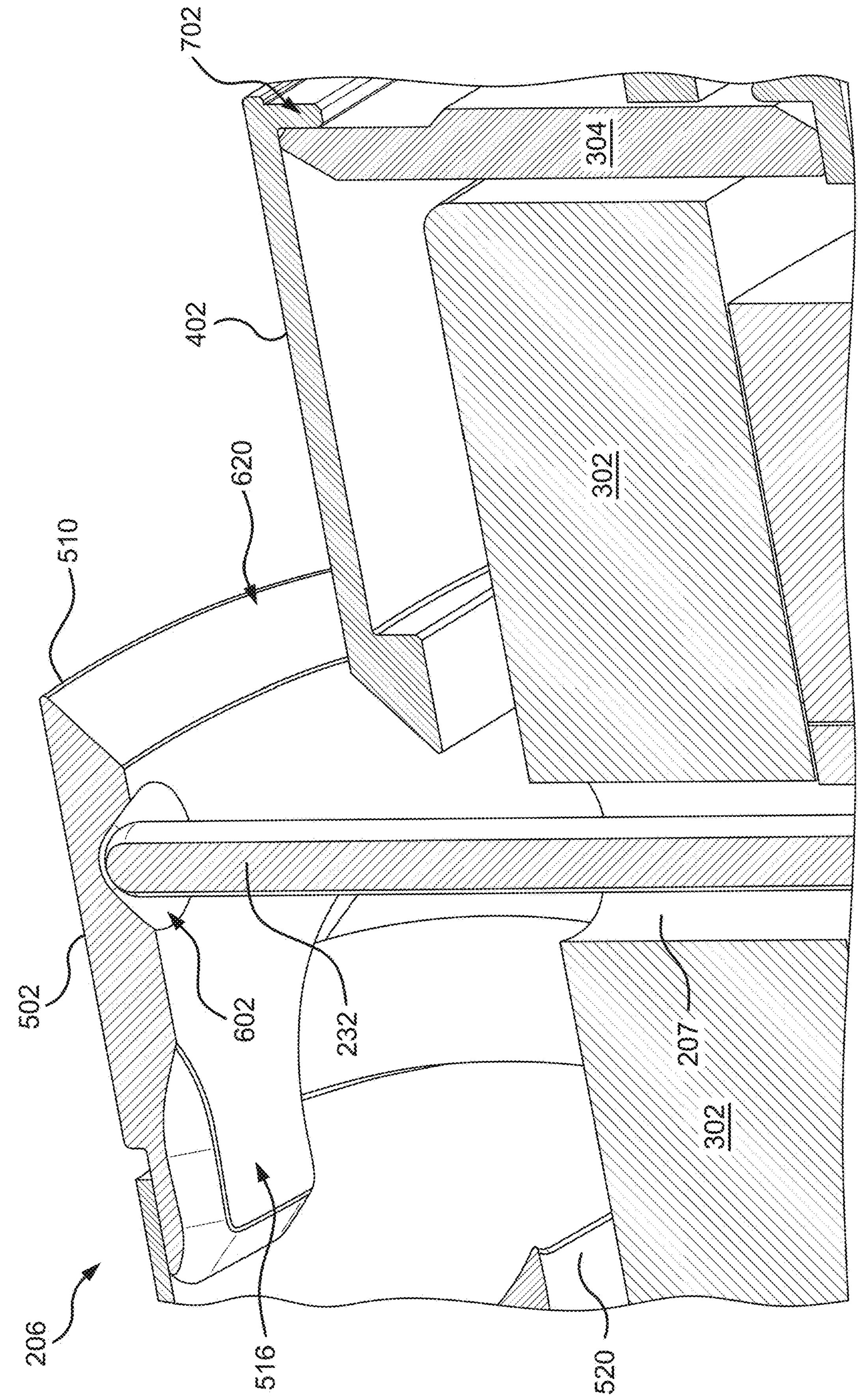


FIG. 7a

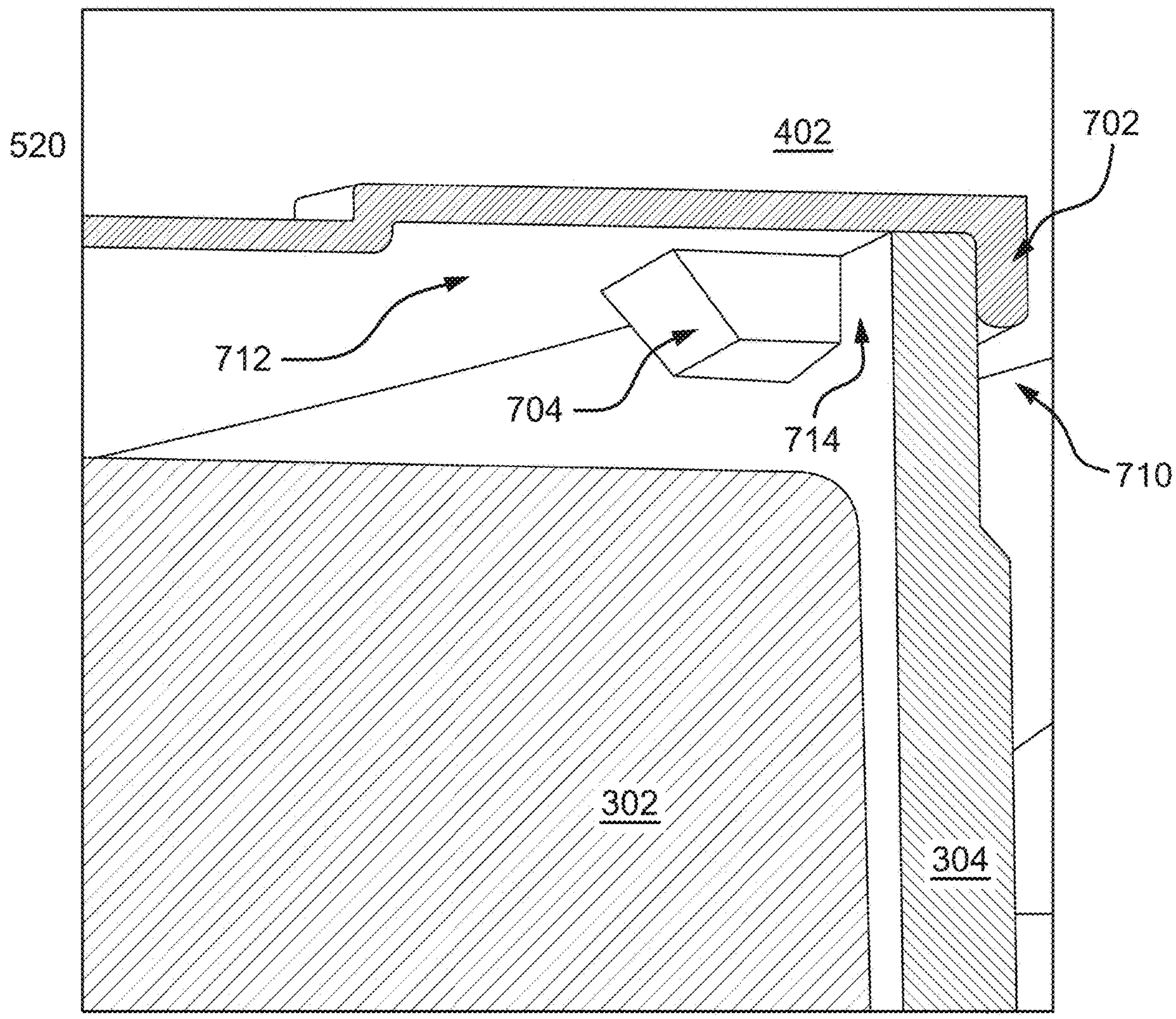


FIG. 7b

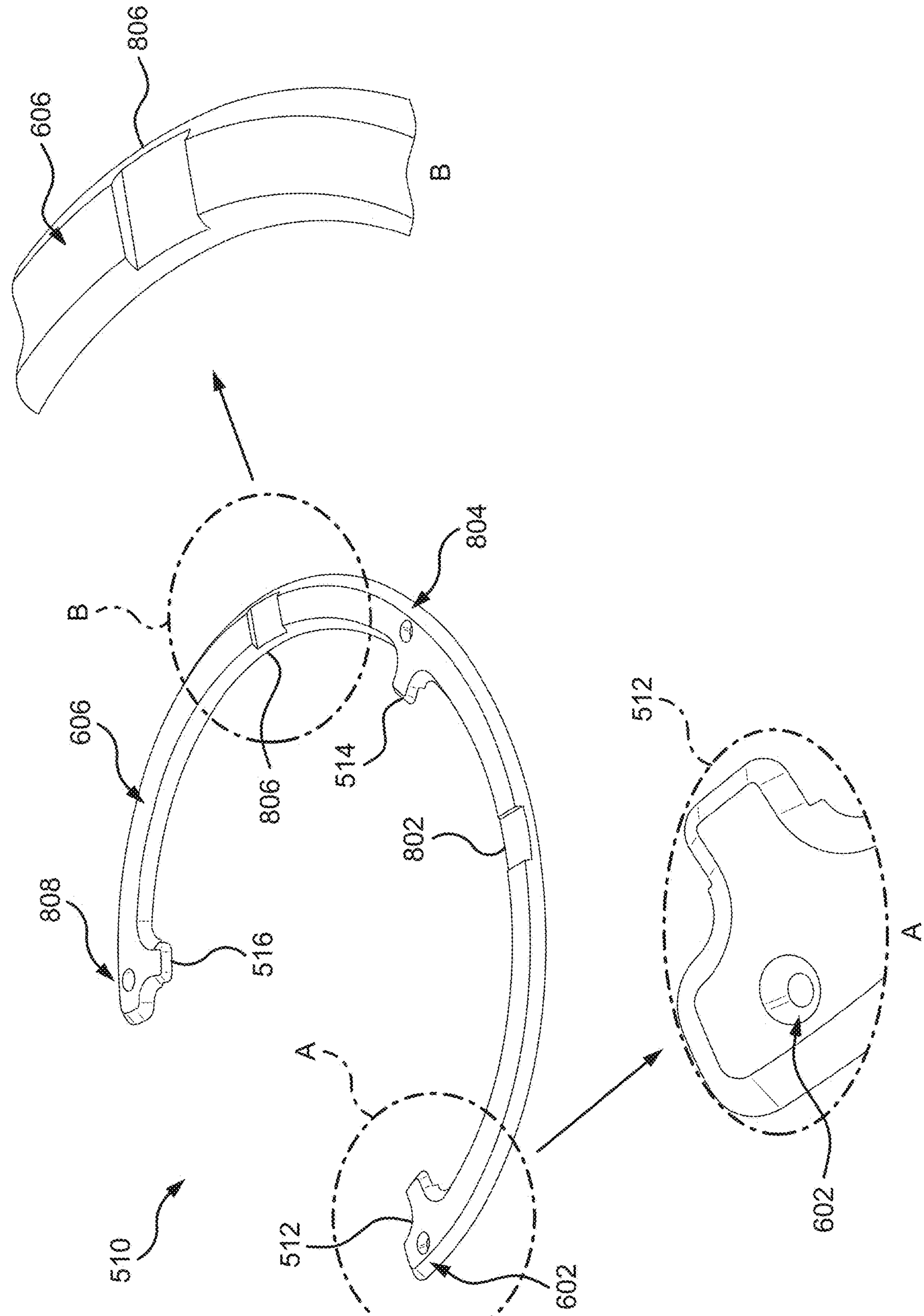


FIG. 8

SUSCEPTOR FOR A SILICON CARBIDE SUBSTRATE

RELATED APPLICATIONS

[0001] This application claims priority to and is a continuation of U.S. patent application Ser. No. 18/438,621, filed Feb. 12, 2024, the contents of which are incorporated herein by reference in its entirety.

BACKGROUND

Field

[0002] The present disclosure generally relates to a susceptor for processing a transparent substrate in a processing chamber. More particularly, embodiments of the present disclosure relate to a susceptor comprising a detachable lift ring for processing a silicon carbide substrate in a processing chamber.

Description of the Related Art

[0003] In recent years, silicon carbide (SiC) substrates have gaining popularities in semiconductor devices, such as power devices for high voltages. SiC offers many advantages comparing to silicon. For example, SiC has a larger band gap and higher breakdown electric field strength than those of silicon. As a result, semiconductor devices made from SiC can operate at a higher voltage, over a wider temperature range, and with a faster switching frequency.

[0004] SiC substrates are known to be transparent to light wavelengths commonly used for heating substrates in a processing chamber. As a result, processing SiC substrates efficiently and rapidly is challenging when using conventional semiconductor processing chambers. Moreover, as SiC substrates allow heating light to pass through, the heating light hat has passed (e.g., leaking) through the substrate can sometime interfere with measurements of thermal sensors in the processing chamber.

[0005] Accordingly, there is a need to have an improved susceptor and a semiconductor processing chamber for processing SiC substrates.

SUMMARY

[0006] Disclosed herein are a detachable part of a susceptor, a susceptor including the detachable part, a substrate support assembly including the susceptor, and a processing chamber having the same. The detachable part includes an arc-shaped rim. The arc-shape rim includes an inner diameter, an outer diameter that is greater than the inner diameter, a first top surface, and a first bottom surface including a plurality of depressions shaped like a frustum. The detachable part further includes a plurality of protrusions disposed along the inner diameter of the arc-shaped rim. The plurality of the protrusions include a second top surface that is disposed below the first top surface.

[0007] According to an example of the present application, the susceptor includes a detachable part detachably coupled with a base part. The base part includes a plurality of cutouts configured to couple with side surfaces of the detachable part. The detachable part includes an arc-shaped rim with an inner diameter, an outer diameter that is greater than the inner diameter, a first top surface, and a first bottom surface having a plurality of depressions shaped like a frustum. The detachable part further includes a plurality of protrusions disposed along the inner diameter of the arc-shaped rim and having a second top surface that is disposed below the first top surface.

[0008] According to another example of the present application, a substrate support assembly includes a body surrounded by a cylindrical ring and a susceptor coupled with the cylindrical ring. The body includes a plurality of pin holes. The susceptor includes a detachable part detachably coupled with a base part that includes a plurality of cutouts whose side surfaces are configured to couple with side surfaces of the detachable part. The detachable part of the susceptor includes components and configurations as described in the present application.

[0009] In another example, a processing chamber is provided. The processing chamber includes a chamber body having an interior volume, a heating module, a susceptor, and a rotatable cylinder. The heating module is arranged to direct radiation into the interior volume. The susceptor has a disk shape and is disposed in the interior volume of the chamber body to support a substrate. The susceptor is rotatable on a vertical axis and fabricated from an opaque material. The rotatable cylinder is disposed in the interior volume and has an upper circumference supporting the susceptor thereon.

[0010] In another example, a processing chamber is provided that a chamber body having an interior volume, a heating module, a disk shaped susceptor, and a rotatable cylinder. The heating module is arranged to direct radiation into the interior volume. The susceptor is fabricated from SiC and is disposed in the interior volume of the chamber body to support a substrate. The susceptor is rotatable on a vertical axis and fabricated from an opaque material. The susceptor includes an inner pocket surrounded by a base rim, and a transitional rim disposed between the base rim and an inner surface of the inner pocket. The inner pocket of the susceptor has a plurality of lift pin holes disposed therethrough. The transitional rim is disposed at an angle of between 2-20 degrees relative to the inner surface. The inner surface is disposed perpendicular to the vertical axis. The rotatable cylinder is disposed in the interior volume and has an upper circumference supporting the susceptor thereon.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] So that the manner in which the above recited features of the present disclosure can be understood in detail, a more particular description of the disclosure, briefly summarized above, may be had by reference to embodiments, some of which are illustrated in the appended drawings. It is to be noted, however, that the appended drawings illustrate only exemplary embodiments and are therefore not to be considered limiting of its scope, may admit to other equally effective embodiments.

[0012] FIG. **1** illustrates a schematic top view of a processing system, according to an embodiment of the present application.

[0013] FIG. **2** illustrates a schematic cross-sectional view of a processing chamber, according to an embodiment of the present application.

[0014] FIG. **3** illustrates a schematic cross-sectional view of a substrate support assembly, according to an embodiment of the present application.

[0015] FIG. **4** illustrates a schematic perspective view of a susceptor, according to an embodiment of the present application.

[0016] FIG. **5** illustrates a schematic perspective view of a susceptor, according to an embodiment of the present application.

[0017] FIG. **6** illustrates a schematic cross-sectional view of the susceptor when the detachable part engages with the base part, according to an embodiment of the present application.

[0018] FIG. **7***a* illustrates a schematic cross-sectional view of the susceptor when the detachable part is lifted up from the base part, according to an embodiment of the present application.

[0019] FIG. **7***b* illustrates a schematic cross-sectional view of a coupling mechanism between the base part and the cylindrical ring, according to an embodiment.

[0020] FIG. **8** illustrates a schematic bottom view of the detachable part, according to an embodiment.

[0021] To facilitate understanding, identical reference numerals have been used, where possible, to designate identical elements that are common to the figures. It is contemplated that elements and features of one embodiment may be beneficially incorporated in other embodiments without further recitation.

DETAILED DESCRIPTION

[0022] The disclosure contemplates that terms such as "couples," "coupling," "couple," and "coupled" may include but are not limited to welding, fusing, melting together, interference fitting, and/or fastening such as by using bolts, threaded connections, pins, and/or screws. The disclosure contemplates that terms such as "couples," "coupling," "couple," and "coupled" may include but are not limited to integrally forming. The disclosure contemplates that terms such as "couples," "coupling," "couple," and "coupled" may include but are not limited to direct coupling and/or indirect coupling, such as indirect coupling through components such as links, blocks, and/or frames.

[0023] Disclosed herein are a detachable part of a susceptor, a susceptor including the detachable part, and a substrate support assembly including the susceptor. The detachable part, the susceptor, and the substrate support assembly can be included in a processing chamber for processing silicon carbide substrates. The susceptor and the detachable part are opaque, which are capable of absorbing the heating light utilized by the processing chamber. For example, the susceptor and the detachable part are made of graphite and coated with a layer of silicon carbide. Other layers may be additionally deposited on the surfaces of the susceptor that can protect the susceptor from the processes. These other layers may include polysilicon, an oxidation layer of silicon carbide, or any other suitable layers. In another example, the susceptor and the detachable part are made of silicon carbide, which is further coated by an oxidation layer of the silicon carbide.

[0024] The detachable part of the susceptor can be lifted up from a base part. The detachable part engages with both the substrate and lift pins. When the lift pins raises the detachable part from the base part, the detachable part lifts up the substrate that is sitting on surfaces of the detachable part. The detachable part has a plurality of depressions, which are blind holes and disposed at the bottom surface of the detachable part. The depressions are aligned with pin holes in a substrate support assembly. Even when the detachable part is lifted from the base part, the blind holes and surrounding opaque materials still block heating light from entering the pin holes of the substrate assembly. When a substrate support assembly includes a susceptor as described in the present application, the heating light of the processing chamber can heat the substrate more efficiently as leakage of the heating light through pin holes is substantially prevented.

[0025] FIG. **1** illustrates a schematic top view of a processing system **100**, according to one or more embodiments. The processing system **100** includes one or more load lock chambers **122** (two are shown in FIG. **1**), a processing platform **104**, a factory interface **102**, and a controller **144**. In one or more embodiments, the processing system **100** includes a CENTURA® integrated processing system, provided by Applied Materials, Inc., located in Santa Clara, California. The one or more load lock chambers may include a rapid thermal processing (RTP) chamber, an epitaxial growth chamber, an etch chamber, and etc. It is contemplated that other processing systems (including those from other manufacturers) may be adapted to benefit from the disclosure.

[0026] The processing platform **104** includes a plurality of processing chambers **110**, **112**, **120**, **128**, the one or more load lock chambers **122**, and a transfer chamber **136** that is coupled to the one or more load lock chamber **122**. The transfer chamber **136** can be maintained under vacuum, or can be maintained at an ambient (e.g., atmospheric) pressure. Two load lock chambers **122** are shown in FIG. **1**. The factory interface **102** is coupled to the transfer chamber **136** through the load lock chambers **122**. According to an embodiment, one or more of the plurality of processing chambers **110**, **112**, **120**, and **128** may be a low temperature EPI chamber, a plasma etch chamber, a chemical vapor deposition chamber, or other processing chamber. At least one of the processing chambers **110**, **112**, **120**, and **128** includes a substrate support assembly **300** including a susceptor (shown in FIG. **2**) and configured to process a silicon carbide substrate according to an embodiment of the present application.

[0027] Continuing to refer to FIG. **1**, the factory interface **102** includes at least one docking station **109** and at least one factory interface robot **114** to facilitate the transfer of substrates **124**. The docking station **109** is configured to accept one or more front opening unified pods (FOUPs). Two FOUPS **106**A, **106**B are shown in the implementation of FIG. **1**. The factory interface robot **114** having a blade **116** disposed on one end of the robot **114** is configured to transfer one or more substrates from the FOUPS **106**A, **106**B, through the load lock chambers **122**, to the processing platform **104** for processing. Substrates being transferred can be stored at least temporarily in the load lock chambers **122**.

[0028] Each of the load lock chambers **122** has a first port interfacing with the factory interface **102** and a second port interfacing with the transfer chamber **136**. The load lock chambers **122** are coupled to a pressure control system (not shown) which pumps down and vents the load lock chambers **122** to facilitate passing the substrates between the environment (e.g., vacuum environment or ambient environment, such as atmospheric environment) of the transfer chamber **136** and a substantially ambient (e.g., atmospheric) environment of the factory interface **102**.

[0029] The transfer chamber **136** has a vacuum robot **130** disposed therein. The vacuum robot **130** has one or more blades **134** (two are shown in FIG. **1**) capable of transferring the substrates **124** between the load lock chambers **122** and the processing chambers **110**, **112**, **120**, and **128**.

[0030] The controller **144** is coupled to the processing system **100** and is used to control processes and methods, such as the operations of the methods described herein (for example the operations of the methods as described in other parts of the present application). The controller **144** includes a central processing unit (CPU) **138**, a memory **140** containing instructions, and support circuits **142** for the CPU. The controller **144** controls various items directly, or via other computers and/or controllers.

[0031] FIG. **2** illustrates a schematic cross-sectional view of a processing chamber **200**, according to an embodiment. The processing chamber **200** can be one or more of the processing chambers **110**, **112**, **120**, and **128** as shown in FIG. **1**. In an embodiment, the processing chamber **200** functions as an RTP chamber configured to rapidly heat a substrate **124** to a processing temperature. The substrate **124** may be a transparent substrate, such as a SiC substrate, although non-transparent substrates may also be processed by the processing chamber **200**.

[0032] The RTP chamber **201** includes a chamber body **50** enclosing an interior volume **210**. Process gases are provided into the interior volume **210**, and an exhaust pump **275** removes exhaust gases the RTP chamber **201**. The chamber body **50** includes a top **203**, a bottom **204**, and one or more sides **205** connecting the top **203** with the bottom **204**. The RTP chamber **201** includes a transparent window **220** that can form part of the top **203** of the chamber body **50**. The RTP chamber **201** includes a rotatable flange **232**. A rotor (not shown) rotates the rotatable flange **232** about the central axis **234**.

[0033] The RTP chamber **201** includes a susceptor **306** coupled with a cylindrical ring **230**. The susceptor **306** supports the substrate **124**. In an embodiment, the susceptor **306** has a plurality of pin holes **207** covered by a detachable part. The substrate **124** can be lifted up or lowered down by the lift pins **245**. In an embodiment, the cylindrical ring **230** may be magnetically coupled to the rotatable flange **232**. Thus, the rotation of the flange **232** can cause the cylindrical ring **230** to rotate, which, in turn, causes the substrate **124** and the susceptor **306** that are positioned on the cylindrical ring **230** rotate. In an embodiment, the susceptor **306** and the cylindrical ring **230** may be rotated independently from the flange **232**.

[0034] The RTP chamber **201** further includes a heating apparatus **224** positioned above the susceptor **306**. The heating apparatus **224** can include a plurality of lamps **226** disposed within reflective tubes. In an embodiment, the plurality of lamps **226** include high-intensity tungsten-halogen lamps arranged in a hexagonal close-packed array above the transparent window **220**. The heating apparatus **224** can rapidly heat the substrate **124** in the interior volume **210** at rates greater than 100° C./second to temperatures as high as 1500° C.

[0035] The RTP chamber **201** further includes a reflector **228** positioned below the susceptor **306** and supported on a base **253**. The reflector **228** can be used to reflect radiation back towards the substrate **124** and susceptor **306**. The reflector **228** can include holes that allow the lift pins **245** to extend and retract through the reflector **228** to raise and lower the susceptor **306**. Each lift pin **245** can be connected to a lift pin actuator **245**A, positioned below the reflector **228**.

[0036] The RTP chamber **201** can further include a plurality of pyrometers **240**, each coupled with a light pipe **242** that extends from a pyrometer to a location below the susceptor **306**. The pyrometers **240** are configured to receive radiation by the susceptor **306** through light pipes **242** to monitor temperatures at different locations (e.g., different radial locations) on the substrate **124**. When a silicon carbide substrate is processed in the RTP chamber **201**, light emitted by the lamps **226** may leak through the pin holes of the susceptor **306** because the silicon carbide substrate is transparent to the light emitted by the lamps **226**. As a result, the measurement of the pyrometers can be interfered and may not reflect an actual temperature of the susceptor **306**.

[0037] According to an embodiment, the susceptor **306** is configured to block light emitted by lamps **226** from leaking through the pin holes **207**. In an example, the susceptor **306** is made of an opaque material that can block the light emitted by the lamps **226**. The opaque material may include graphite, black quartz, or any other suitable materials. The susceptor **306** may have coatings covering the opaque material. The coating may be made of silicon carbide.

[0038] According to an embodiment, the pin holes **207** do not pass through all parts of the susceptor **306**. In an example, the susceptor **306** includes a detachable part sitting on a base part. The pin holes **207** may be disposed in the base part. The detachable part does not have pin holes and is configured to covers the plurality of pin holes **207**. When the substrate **124** is lifted up by the lift pins **245**, the detachable part is configured to move with the substrate **124**. Thus, when pin holes **207** are exposed after the substrate **124** is raised, the detachable part is still positioned right above the pin holes **207** and is configured to block light of the lamps **226** from leaking through the pin holes **207**.

[0039] FIG. **3** illustrates a schematic cross-sectional view of a substrate support assembly **300** having a susceptor **306**, according to an embodiment. The substrate support assembly **300** includes a body **302**, a cylindrical ring **304**, and a susceptor **306**. The body **302** includes a plurality of pin holes **207** that allow lift pins **232** to pass through. The cylindrical ring **304** encloses the body **302** and supports the susceptor **306** via a top surface **310** of the cylindrical ring **304**. The susceptor **306** includes a skirt **312** that overlaps with the cylindrical ring **304**.

[0040] According to an embodiment, the cylindrical ring **304** and the susceptor **306** includes a material which is opaque to the radiation emitted by the heating apparatus **224**. The opaque material may include graphite, black quartz, polysilicon, or any other suitable materials. The opaque material may be used as a body of the susceptor **306** or a surface layer of the susceptor **306**. In an example, the cylindrical ring **304** is made of black quartz. In another example, the susceptor **306** includes a body made of graphite and a surface layer of silicon carbide covering the graphite. A layer of polysilicon or oxidized silicon carbide may also be further included to cover the silicon carbide. In another example, the susceptor **306** includes a body made of silicon carbide and a layer of polysilicon covering the silicon carbide. In yet another example, the susceptor **306** includes a body made of silicon carbide and an oxidation layer of the silicon carbide.

[0041] As shown in FIG. **3**, the substrate **124** is lifted to a position spaced above the susceptor **306**. A blade **134** can be extended under the lifted substrate **124** through a door **314** of the processing chamber **200**. The substrate **124** can be transferred from the lift pin **232** to the blade **134**. The blade **134** may the move the substrate **124** out of the processing chamber **200** via the door **314**.

[0042] FIG. **4** illustrates a perspective view of a cylindrical ring **304** and a susceptor **306**, according to an embodiment. The cylindrical ring **304** is substantially annular and extends along a vertical direction **420**, which is perpendicular to a horizontal plane **422** defined by a top surface **424** of an inner pocket **404** of the susceptor **306**. The height **416** of the cylindrical ring **304** is greater than that of the body **302** (shown in FIG. **3**). The cylindrical ring **304** includes a plurality of notches **412** disposed at an upper circumference **426** of the cylindrical ring **304**. The plurality of notches **412** are configured to align the susceptor **306** with the cylindrical ring **304** and retain the susceptor **306** on the cylindrical ring **304**. The cylindrical ring **304** includes a plurality of notches **414** disposed at a bottom surface of the cylindrical ring **304**. The plurality of notches **414** are configured to align the cylindrical ring **304** with the body **302** and retain the cylindrical ring **304** on the body **302**. The cylindrical ring **304** further includes a chamfered surface **418** disposed along the upper circumference **426** of the cylindrical ring **304** and inclined inwardly toward a center of the cylindrical ring **304**.

[0043] The susceptor **306** is substantially annular and includes an inner pocket **404**, a base rim **402** surrounding and coupled to the inner pocket **404**, and a transitional rim **408** disposed between the inner pocket **404** and the base rim **402**. The inner pocket **404** may be slightly lower than a top surface **410** of the base rim **402**. The inner pocket **404** is sized to receive the substrate **124** such that the substrate **124** fits just inside the base rim **402**. The inner pocket **404**, the base rim **402**, and the transitional rim **408** are configured to prevent the substrate **124** from slipping out during processing. The inner pocket **404** is provided with a number of pin holes **406**, for example three (3) pin holes, corresponding to the placement of pin holes **207** of the body **302** (shown in FIG. **3**). In one example, the pin holes **406** may be arranged at 120 degree intervals along the circumference of the inner pocket **404**.

[0044] The transitional rim **408** may have an angled surface **409**. The angled surface **409** may be inclined toward the inner pocket **404**. The angled surface **409** may be angled between about 2 degrees to about 20 degrees, such as about 6 degrees to about 15 degrees.

[0045] FIG. **5** illustrates a perspective view of a susceptor **500**, according to another embodiment, that is suitable for use in the processing chamber **200**, among others. The susceptor **500** includes a base part **520** and a detachable part **510**. The shape and size of the susceptor **500** are generally similar with that of the susceptor **306**. Comparing to the susceptor **306**, which is a single piece, the susceptor **500** includes multiple detachable pieces. For example, the base part **520** and the detachable part **510** of the susceptor **500** are detachable. A substrate can be supported by the detachable part **510**. Thus, when the detachable part **510** is lifted up by a plurality of lift pins, the detachable part **510** lifts up the substrate that sits on a surface of the detachable part **510**.

[0046] The detachable part **510** functions as a lift ring. The detachable part **510** includes an inner diameter **504** and an outer diameter **506**, which is greater than the inner diameter **504**. The detachable part **510** has sufficient material coverage to function as a blackout zone that blocks infrared (IR) light from entering the pin holes. The detachable part **510** includes an arc-shape rim **502** coupled with a plurality of protrusions **512**, **514**, and **516** disposed along the inner diameter **504**. The plurality of protrusions **512**, **514** and **516** include a top surface **508** that support a substrate **124**. The top surface **508** of the protrusions **512**, **514**, and **516** is disposed below a top surface **509** of the arc-shaped rim **502**. The plurality of protrusions **512**, **514**, and **516** extend from the inner diameter **504** inwardly along a horizontal plane into an inner side **511** of the detachable part **510**. The detachable part **510** form an open arc with two opposing ends **501** and **503**. Between the two opposing ends **501** and **503**, an open segment **518** is formed and configured to allow a robotic blade **134** to move into the inner side **511**. In an embodiment, a bottom surface **618** of the protrusions is disposed at the same level as the bottom surface **612** of the base rim **402** (shown in FIG. **6**).

[0047] The base part **520** includes an inner pocket **404**, a base rim **402**, and a transitional rim **408**. The base part **520** further includes a plurality of cutouts **522**, **524**, and **526** that couple with the detachable part **510**. The plurality of cutouts **522**, **524**, and **526** are disposed mainly in the base rim **402**. The plurality of cutouts **522**, **524**, and **526** further include cutouts **528**, **530**, and **532** that extend into the inner pocket **404**. The cutouts **528**, **530**, and **532** are disposed in a close proximity to pin holes **207** of the body **302** (shown in FIG. **3**). The plurality of cutouts **522**, **524**, and **526** include chamfered side surfaces **538** and **540** configured to couple with the side surfaces of the detachable part **510**.

[0048] Continuing to refer to FIG. **5**, the base part **520** includes a plurality of tabs **534** and **536** disposed within the cutouts **522**, **524**, and **526**. The plurality of tabs **536** and **354** couple with slots **806** of the detachable part **510** (shown in FIG. **8**) to support the detachable part **510**. The tabs **534** and **536** couple the inner pocket **404** with the base rim **402**.

[0049] FIG. **6** illustrates a schematic cross-sectional view of the susceptor **500** according to an embodiment. FIG. **6** illustrates a configuration when the detachable part **510** and the base part **520** are engaged with each other. In this configuration, a substrate **124** is supported by both the inner pocket **404** and the protrusion **516**. To create an even support surface for the substrate **124**, the protrusion **516** of the detachable part **510** is flushed with the inner pocket **404** of the base part **520**. For example, the top surface **508** of the protrusion **516** is disposed at the same level as a top surface **614** of the inner pocket **404**. The arc-shaped rim **502** of the detachable part **510** is flushed with the base rim **402** of the base part **520**. For example, a top surface **604** of the arc-shaped rim **502** is disposed at the same level as the top surface **610** of the base rim **402**.

[0050] Also shown in FIG. **6** is that the chamfered side surfaces **538** of the base part **520** engage with the side surfaces **620** of the detachable part **510**. In an embodiment, the side surfaces **624** of the base rim **402** are inclined and form acute angles **622** with the top surface **604**.

[0051] In an embodiment, the bottom surfaces **617**, **618**, **606**, and **612** of the inner pocket **404**, protrusion **516**, arc-shaped rim **502**, and the base rim **402** are disposed at the same level. The arc-shaped rim **502** is disposed above and coupled with the cylindrical ring **304**.

[0052] Continuing to refer to FIG. **6**, a depression **602** is disposed within the arc-shaped rim **502** and is aligned with pin holes **207** of the body **302**. Comparing to the pin holes **207**, the depression **602** functions a blind hole that blocks light emitted by the heating module **155** from passing through the detachable part **510**. The depression **602** is shaped like a frustum with a chamfered surface **616** extending from the bottom surface **606** to an inside of the depression **602**. The diameter of the depression **602** is sized to be greater than a lift pin **232** such that the depression **602** can receive a lift pin and guide the lift pin into a desired position.

[0053] FIG. **7***a* illustrates a schematic perspective cross-sectional view of a substrate assembly **206** when the detachable part **510** of a susceptor **500** is lifted, according to an embodiment. The substrate support assembly **300** includes a body **302** coupled with a cylindrical ring **304**. The base rim **402** is disposed on top of the cylindrical ring **304** and includes a skirt **702** extending downwardly to cover a portion of the cylindrical ring **304**. The cylindrical ring **304** is disposed between the skirt **702** and the body **302**. A lift pin **232** engages with the depression **602** of the arc-shaped rim **502** and lifts the detachable part **510** from the base part **520**. The depression **602** is disposed above and aligned with the pin hole **207**. The protrusion **516** extends under and contacts a substrate **124**. The side surface **620** of the detachable part **510** is inclined toward the depression **602**.

[0054] FIG. **7***b* illustrates a schematic cross-sectional view of a coupling mechanism **710** between the base part **520** and the cylindrical ring **304**, according to an embodiment. Comparing with FIG. **7***a*, the base part **520** additionally includes a projection **704** disposed at a bottom surface **712** of the base rim **402**. The projection **704** extends from the bottom surface **712** downwardly. The projection **702** has a side surface **714** facing the skirt **702** and is substantially parallel with the skirt **714**. The gap between the side surface **714** and the skirt **702** is configured to be about the thickness of the cylindrical ring **304**. When the base part **520** is coupled with the cylindrical ring **304**, an upper portion of the cylindrical ring **304** can contact both the side surface **714** and the skirt **702** snugly, thus securing the base part **520** in place. In an embodiment, the projection **404** has a trapezoid shape. One side of the two parallel sides of the projection **704** contacts with the bottom surface **712** and has a greater length than the other side of the two parallel sides. The projection **704** could be of any shape as long as the side surface **714** generally conforms to the shape of the cylindrical ring **304**.

[0055] FIG. **8** illustrates a schematic bottom view of the detachable part **510** and two callouts A and B showing details of certain configurations, according to an embodiment. The detachable part **510** includes a plurality of depressions **602**, **804**, and **808**. According to an embodiment, three (3) depressions are disposed on the bottom surface at 120 degree intervals. The plurality of protrusions **512**, **514**, and **516** are disposed in a close proximity to the plurality of depressions **602**, **804**, and **808**, respectively. As shown in Callout A, the depression **602** has a frustum-like shape. The detachable part **510** further includes a plurality of slots **802** and **806** disposed on the bottom surface **606** of the arc-shaped rim. As shown in Callout B, the plurality of slots **802** and **806** traverse the bottom surface **606** along a horizontal plane. The plurality of slots **802** and **806** are configured to engage with the tabs **534** and **536** (shown in FIG. **5**).

[0056] It is contemplated that one or more aspects disclosed herein may be combined. Moreover, it is contemplated that one or more aspects disclosed herein may include some or all of the aforementioned benefits. While the foregoing is directed to embodiments of the present disclosure, other and further embodiments of the disclosure may be devised without departing from the basic scope thereof, and the scope thereof is determined by the claims that follow.

What is claimed is:

1. A processing chamber comprising:

a chamber body having an interior volume;

a heating module arranged to direct radiation into the interior volume;

a susceptor having a disk shape and disposed in the interior volume of the chamber body to support a substrate, the susceptor rotatable on a vertical axis and fabricated from an opaque material; and

a rotatable cylinder disposed in the interior volume and having an upper circumference supporting the susceptor thereon.

2. The processing chamber of claim **1**, wherein the susceptor further comprises:

an inner pocket surrounded by a base rim, the inner pocket of the susceptor having a plurality of lift pin holes disposed therethrough.

3. The processing chamber of claim **2**, wherein the susceptor further comprises:

a transitional rim disposed between the base rim and an inner surface of the inner pocket, the transitional rim disposed at an angle of between 2-20 degrees relative to the inner surface, the inner surface disposed perpendicular to the vertical axis.

4. The processing chamber of claim **3**, wherein the upper circumference of the rotatable cylinder includes an upper notch configured to configured to align the susceptor with the rotatable cylinder and retain the susceptor on the rotatable cylinder.

5. The processing chamber of claim **4**, wherein a bottom surface of the rotatable cylinder includes a lower notch, the lower notch configured to configured to align the rotatable cylinder with a body of substrate support and retain the rotatable cylinder on the body, the body circumscribed by the rotatable cylinder.

6. The processing chamber of claim **2**, further comprising:

a base disposed below the susceptor, the base having a plurality of lift pin holes that align with the plurality of lift pin holes disposed through the inner pocket.

7. The processing chamber of claim **6**, wherein the upper circumference of the rotatable cylinder includes an upper notch configured to configured to align the susceptor with the rotatable cylinder and retain the susceptor on the rotatable cylinder.

8. The processing chamber of claim **7**, wherein a bottom surface of the rotatable cylinder includes a lower notch, the lower notch configured to configured to align the rotatable cylinder with a body of substrate support and retain the rotatable cylinder on the body, the body circumscribed by the rotatable cylinder.

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

a skirt extending from a bottom surface of the base rim and overlapping the upper circumference of the rotatable cylinder.

10. The processing chamber of claim **1**, wherein the susceptor is fabricated from graphite coated with SiC.

11. The processing chamber of claim **1**, wherein the susceptor is fabricated from SiC.

12. The processing chamber of claim **11**, wherein the SiC susceptor is coated with SiC or polysilicon.

13. The processing chamber of claim **1**, further comprising:

a window separating the heating module from the susceptor.

14. The processing chamber of claim **1**, further comprising:

a rotatable flange magnetically coupled to the rotatable cylinder, wherein rotation of the flange causes rotation of the susceptor supported on the rotatable cylinder.

15. A processing chamber comprising:

a chamber body having an interior volume;

a heating module arranged to direct radiation into the interior volume;

a disk shaped susceptor fabricated from SiC and disposed in the interior volume of the chamber body to support a substrate, the susceptor rotatable on a vertical axis and fabricated from an opaque material, the susceptor comprising:

an inner pocket surrounded by a base rim, the inner pocket of the susceptor having a plurality of lift pin holes disposed therethrough; and

a transitional rim disposed between the base rim and an inner surface of the inner pocket, the transitional rim disposed at an angle of between 2-20 degrees relative to the inner surface, the inner surface disposed perpendicular to the vertical axis; and

a rotatable cylinder disposed in the interior volume and having an upper circumference supporting the susceptor thereon.

16. The processing chamber of claim **15**, wherein the upper circumference of the rotatable cylinder includes an upper notch configured to configured to align the susceptor with the rotatable cylinder and retain the susceptor on the rotatable cylinder.

17. The processing chamber of claim **16**, wherein a bottom surface of the rotatable cylinder includes a lower notch, the lower notch configured to configured to align the rotatable cylinder with a body of substrate support and retain the rotatable cylinder on the body, the body circumscribed by the rotatable cylinder.

18. The processing chamber of claim **15**, wherein the susceptor is fabricated from graphite coated with SiC.

19. The processing chamber of claim **15**, wherein the susceptor is fabricated from SiC.

20. The processing chamber of claim **15**, wherein the SiC susceptor is coated with SiC or polysilicon.

* * * * *