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(54) **Title**: AN ELECTROSTATIC CHUCK FOR HIGH TEMPERATURE PROCESS APPLICATIONS

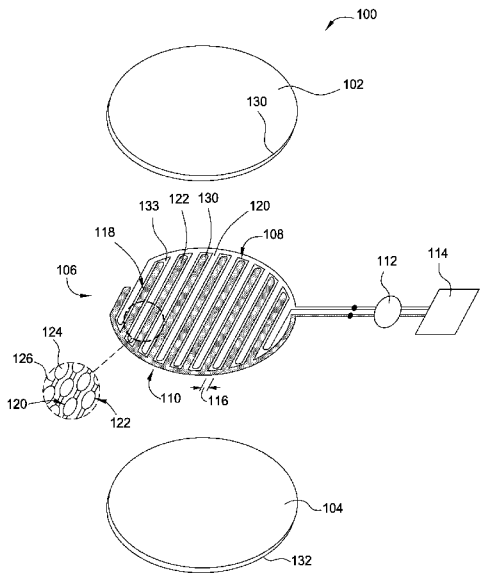


FIG. 1

(57) **Abstract**: Embodiments of the present invention provide a substrate support assembly including an electrostatic chuck with enhanced heat resistance. In one embodiment, an electrostatic chuck includes a support base, an electrode assembly having interleaved electrode fingers formed therein, and an encapsulating member disposed on the electrode assembly, wherein the encapsulating member is fabricated from one of a ceramic material or glass.

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AN ELECTROSTATIC CHUCK FOR HIGH TEMPERATURE PROCESS APPLICATIONS

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] Embodiments of the invention generally relate to a substrate support assembly, more specifically, for an electrostatic chuck having an encapsulating member formed thereon with enhanced heat resistance suitable for use in a plasma processing chamber.

Description of the Related Art

[0002] Ultra-large-scale integrated (ULSI) circuits may include more than one million electronic devices (*e.g.,* transistors) that are formed on a semiconductor substrate, such as a silicon (Si) substrate, and cooperate to perform various functions within the device. Typically, the transistors used in the ULSI circuits are complementary metal-oxide-semiconductor (CMOS) field effect transistors. A CMOS transistor has a gate structure comprising a polysilicon gate electrode and gate dielectric, and is disposed between a source region and drain regions that are formed in the substrate.

[0003] During manufacture of the integrated circuits, display devices or other semiconductor related products, a number of different chemical and physical processes are involved whereby minute transistor devices are created on a substrate. Layers of materials which make up the transistor devices are created by chemical vapor deposition, physical vapor deposition, epitaxial growth, and the like. Some of the layers of material are patterned using photoresist masks and wet or dry etching techniques. The substrate utilized to form transistor devices may be silicon, quartz, sapphire, gallium arsenide, indium phosphide, glass, or other appropriate material. In some applications, flexible substrates, polymer substrates or plastic substrates may also be utilized.

[0004] A typical plasma processing chamber includes a chamber body defining a process zone, a gas distribution assembly adapted to supply a gas from a gas supply into the process zone, a gas energizer, *e.g.,* a plasma generator, utilized to energize the process gas used to process a

substrate positioned on a substrate support assembly, and a gas exhaust. The substrate support assembly may include an electrostatic chuck that holds the substrate to the substrate support assembly during processing. Conventionally, for a thin substrate process, such as a substrate having a thickness less than 200 μm, an electrostatic chuck configured for low temperature processing is often used. The low temperature processing electrostatic chuck includes a laminated structure having a polymer-type underlayer, an electrode disposed on the polymer-type underlayer and a polymer-type encapsulating overlayer disposed on the electrode. This particular type of electrostatic chuck with polymer-type underlayer and polymer-type encapsulating overlayer is believed to be advantageous for processing thinned substrate for LED/OLED manufacturing, semiconductor manufactured on thin sapphire, touch screen/touch panel and other display device applications.

[0005] In high temperature plasma processing applications, the temperature within the chamber may be greater than 300 degrees Celsius. Conventional electrostatic chucks with polymer-type encapsulating layers may not be suitable for use in such high temperature processes as the high temperature of corrosive species generated during plasma may melt or erode the polymer-type layers, resulting in inconsistent or undesirable electrical properties of the chuck which adversely affects the chuck's ability to hold substrates. Typically, the electrostatic chuck with polymer-type encapsulating layers can only sustain process temperature less than 250 degrees Celsius without failure. Thus, it would be desirable to have an electrostatic chuck having enhanced heat resistance as well as the capability to chuck thin substrates during processing.

[0006] Therefore, there is a need for an improved electrostatic chuck that provides enhanced heat resistance during processing.

SUMMARY OF THE INVENTION

[0007] Embodiments of the present invention provide a substrate support assembly having an electrostatic chuck that enhances heat resistance. The electrostatic chuck may provide an encapsulating layer with high heat resistance on the electrostatic chuck, thereby improving the service life of the

substrate support assembly while reducing maintenance and manufacturing cost.

[0008] In one embodiment, an electrostatic chuck includes a support base, an electrode assembly having interleaved electrode fingers formed therein, and an encapsulating member disposed on the electrode assembly, wherein the encapsulating member is fabricated from one of a ceramic material or glass.

[0009] In another embodiment, a method for fabricating an electrostatic chuck includes disposing an electrode assembly on a support base, wherein the electrode assembly includes a plurality of intervening electrode fingers, and forming an encapsulating member on the electrode assembly, wherein the encapsulating member is fabricated from a glass or ceramic material.

[0010] In yet another embodiment, an electrostatic chuck includes a support base fabricated from glass or a ceramic material, an electrode assembly disposed on the support base, wherein the electrode assembly has at least two independently bias able electrodes having a plurality of interleaving electrode fingers formed therein, and an encapsulating member disposed on the electrode assembly, the encapsulating member fabricated from a glass or ceramic material having a coefficient of thermal expansion substantially matching the coefficient of thermal expansion of a material forming the electrode assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] So that the manner in which the above recited features of the present invention can be understood in detail, a more particular description of the invention, briefly summarized above, may be had by reference to embodiments, some of which are illustrated in the appended drawings.

[0012] Figure 1 depicts an exploded view of one embodiment of an electrostatic chuck according the present invention;

[0013] Figure 2 depicts a second view of a substrate support assembly with the electrostatic chuck of Figure 1 utilized therein according the present invention; and

[0014] Figure 3 depicts a flow diagram of a method for manufacturing an electrostatic chuck in accordance with one embodiment of the present invention;

and

[0015] Figures 4A-4C depict a sequence for manufacturing an electrostatic chuck in accordance with one embodiment of the invention.

[0016] It is to be noted, however, that the appended drawings illustrate only typical embodiments of this invention and are therefore not to be considered limiting of its scope, for the invention may admit to other equally effective embodiments.

[0017] To facilitate understanding, identical reference numerals have been used, wherever possible, to designate identical elements that are common to the figures. It is contemplated that elements of one embodiment may be advantageously utilized in other embodiments without further recitation.

DETAILED DESCRIPTION

[0018] Embodiments of the present invention provide a substrate support assembly including an electrostatic chuck having an encapsulating layer having a distributed electrode disposed therein, the encapsulating layer having enhanced heat resistance and plasma resistance, compared to conventional polymer-type electrostatic chucks. In one embodiment, the encapsulating layer may be an insulating layer made from a ceramic material or a glass material. In one embodiment, the insulating layer provides enhanced heat resistance surface on the substrate support assembly, thereby improving the service life of the substrate support assembly and increasing the process window, while reducing maintenance and manufacturing cost. Although the description provided herein describes an electrostatic chuck suitable for vacuum processing a semiconductor substrate, it is contemplated that the electrostatic chuck may be configured to use to electrostatically chuck other workpieces, such as glass panels, plastic panels, LED substrates, or other electrostatically retainable substrates or workpieces. Furthermore, the electrostatic chuck may be a stationary workpieces securely positioned in a processing chamber, or moveable carrier configured to transfer substrates, such as thin substrates, in a processing chamber.

[0019] Figure 1 depicts an exploded view of one embodiment of an

electrostatic chuck 100. The electrostatic chuck 100 may be used in any suitable plasma process, including physical vapor deposition (PVD) process, chemical vapor deposition (CVD) process, etching process, or any suitable plasma or vacuum process. The electrostatic chuck 100 may also be adapted for use in non-plasma and non-vacuum environments, particularly for high temperature applications. Although one embodiment of an electrostatic chuck 100 is disposed herein, it is contemplated that the electrostatic chuck may have other configurations.

[0020] The electrostatic chuck 100 includes a rigid support base 104, an electrode assembly 106 disposed on the rigid support base 104, and an encapsulating member 102 disposed on the electrode assembly 106. The rigid support base 104 may have any suitable shapes selected for handling a specific workpiece, and in the illustrative example depicted in Figure 1, the rigid support base 104 has a circular-like shape having a periphery 132 that substantially matches the shape and size of electrode assembly 106 and the rigid support base 104 sequentially formed thereon to allow a substrate with similar shape and size to be disposed thereon. It is noted that the rigid support base 104 may be in any shapes or configurations as needed. In one embodiment, the rigid support base 104 may be fabricated from an insulating material, such as a dielectric material or a ceramic material. Suitable examples of the ceramic materials or dielectric materials include silicon oxide, such as quartz or glass, sapphire, aluminum oxide (Al_2O_3), aluminum nitride (AlN), yttrium containing materials, yttrium oxide (Y_2O_3), yttrium-aluminum-garnet (YAG), titanium oxide (TiO), titanium nitride (TiN), silicon carbide (SiC) and the like. Optionally, the rigid support base 104 may be a metallic body having a dielectric layer disposed on the surface facing the electrostatic assembly 106.

[0021] The electrode assembly 106 disposed on the rigid support base 104 includes at least two sets of distributed electrodes 108, 110. Each electrode 108, 110 may be charged with different polarities as needed when a voltage power is applied thereto, thus generating an electrostatic force. The electrodes 108, 110 are configured to distribute the electrostatic force along a distance at least two times with width of the electrostatic chuck 100. Each electrode 108,

110 may each have a plurality of electrode fingers 120, 122 intervening with each other. It is believed that electrode interleaved fingers 120, 122 provides local electrostatic attraction distributed across a large area of the electrostatic chuck 100 which in the aggregation provides a high chucking force while using less chucking power. The electrode fingers 120, 122 may be formed to have different lengths and geometry. In one example, one or both of the electrode fingers 120, 124 may be formed from interconnected electrode islands 124. Interconnections 126 between electrode islands 124 may be in the plane of the electrodes 108, 110 as shown in Figure 1, or out of plane, such as in the form of jumpers and/or vias. In one embodiment, the electrode finger 120, 122 has a width 116 of between about 0.25 mm and about 10 mm.

[0022] Between each of the electrode fingers 120 of the first electrode 108, spaces 133 are defined to receive electrode fingers 122 of the second electrode 110. The spaces 133 may be an air gap, filled with a dielectric spacer material, or filled with at least one of the rigid support base 104 or encapsulating member 102.

[0023] A power source 114 is coupled to the first and the second electrode 108, 110 through a power switch 112. The power source 114 is configured to provide a voltage power to the first and the second electrode 108, 110 to generate charges with different polarities, either positive or negative charges. The positive or negative charges generated from the first and the second electrode 108, 110 provide an electrostatic force to attract a substrate disposed in the electrostatic chuck 100 in a secured position. In one embodiment, the power source 114 may be configured to provide a DC or AC power to the first and the second electrodes 108, 110.

[0024] The encapsulating member 102 is disposed on the rigid support base 104 sandwiching the electrode assembly 106, to form the electrostatic chuck 100 as a unitary structure. The encapsulating member 102 is positioned on the electrode assembly 106 to provide an insulating surface on which the substrate is chucked. The encapsulating member 102 may be fabricated by a material having thermal properties, *e.g.,* coefficient of thermal expansion, substantially matching that of the underlying electrode assembly 106, and in some

embodiments, also the rigid support base 104.

[0025] After the encapsulating member 102, the electrode assembly 106 and the rigid support base 104 are stacked in a predetermined order, a bonding process, such as an annealing process, is performed to fuse the encapsulating member 102, the electrode assembly 106 and the rigid support base 104 together, forming a laminated structure of the electrostatic chuck 100 as an integral part. As the encapsulating member 102, the electrode assembly 106 and the rigid support base 104 may be required to operate in a high temperature environment, *e.g.,* greater than 300 degrees Celsius, the materials utilized to fabricate these three components may be selected from heat resistance materials, such as ceramic materials or glass materials, that can sustain high thermal treatment during the heat process. In one embodiment, the encapsulating member 102 and the rigid support base 104 may be fabricated from a ceramic material, a glass material, or a composite of ceramic and metal material, providing good strength and durability as well as good heat transfer properties. The materials selected to fabricate the encapsulating member 102 and the rigid support base 104 may have a coefficient of thermal expansion that is substantially matched to the intermediate electrode assembly 106 to reduce thermal expansion mismatch, which may cause stress or failure under high thermal loads. In one embodiment, the coefficient of thermal expansion of the encapsulating member 102 is between about 2 μm/(m*K) and about 8 μm/(m*K). Ceramic materials suitable for fabricating the encapsulating member 102 and the rigid support base 104 may include, but not limited to, glass, sapphire, silicon carbide, aluminum nitride, aluminum oxide, yttrium containing materials, yttrium oxide (Y_2O_3), yttrium-aluminum-garnet (YAG), titanium oxide (TiO), or titanium nitride (TiN). In another embodiment, the encapsulating member 102 and the rigid support base 104 may be fabricated from a composite material includes a different composition of a ceramic and metal, such as metal having dispersed ceramic particles.

[0026] In one embodiment, the electrode assembly 106 may be fabricated from a metallic material, such as molybdenum, having a coefficient of thermal expansion similar to the adjacent encapsulating member 102 and the rigid

support base 104. In one embodiment, the coefficient of thermal expansion of the electrode assembly 106 is between about 4 μm/(m*K) and about 6 μm/(m*K), and is generally within 20 percent of the coefficient of thermal expansion of the encapsulating member 102.

[0027] During operation, a negative charge may be applied to the first electrode 108 and a positive charge may be applied to the second electrode 110, or vise versa, to generate an electrostatic force, when a power is supplied to the power source 114. During chucking, the electrostatic force generated from the electrodes 108, 110 chucks and holds the substrate disposed thereon in a secured position. As the power supplied from the power source 114 is turned off, the charges present in the interface 118 between the electrodes 108, 110 may be maintained over a long period of time. To release the substrate held on the electrostatic chuck 100, a short pulse of power in the opposite polarity is provided to the electrodes 108, 110 to remove the charge present in the interface 118.

[0028] Figure 2 describes a sectional view of one embodiment of a substrate support assembly 200 having the electrostatic chuck 100 implemented on a pedestal 202. The substrate support assembly 200 can then be further placed in a processing chamber, such as a plasma processing vacuum chamber, to hold a substrate 204 disposed thereon during processing. It is noted that although the substrate support assembly 200 described herein is used for vacuum plasma processing, it is noted that the substrate support assembly 200 in any suitable processing tools, including those processing equipments working under atmosphere or any conditions.

[0029] As depicted in the cross sectional view of Figure 2, the electrode assembly 106 may include the first electrode 108 and the second electrode 106 with intervening electrode fingers 120, 122. In the example depicted in Figure 2, a negative charge is applied to the first electrode 108 and a positive charge is applied to the second electrode 110. The negative and positive charges generated from the electrode assembly 106 respectively induce the substrate 204 to generate charges with opposite polarities, *i.e.,* positive charges and negative charges, thereby generating an electrostatic force to chuck the

substrate 204 on the substrate support assembly 200. For example, negative charges present on the electrode fingers 120 of the first electrode 108 may induce the substrate 204 to locally generate positive charges 206, so as to create electrostatic force to securely position to the substrate 204 on the substrate support assembly 200. Similarly, positive charges present on the electrode fingers 122 of the second electrode 110 may induce the substrate 204 to locally generate negative charges 210. By utilizing the intervening finger electrodes 120, 122 of the first and the second electrode 108, 110, an enhanced and localized electrostatic field may be created which is distributed across a greater area of the electrostatic chuck 100 due to the long length of the interface 118 defined between the fingers 120, 122, generating an electrostatic attraction to the substrate, helping to retain the substrate 204 on the substrate support assembly 200 using less chucking power compared to conventional eoectrostatic chucks. Additionally, the ability to maintain the chucking force to the substrate 204 enables the substrate 204 to be retained on the substrate support assembly 200 without power supplied to the electrode assembly 106, thereby reducing likelihood of charging defects created on thin substrates 204 and substrate breakage and damage.

[0030] Figure 3 depicts a flow diagram of a method for manufacturing an electrostatic chuck in accordance with one embodiment of the present invention. Figures 4A-4C depict a sequence for manufacturing the electrostatic chuck of Figure 3 in accordance with one embodiment of the invention. The method 300 starts at the step 302 by providing an rigid support base 402, having a first surface 404 and a second surface 406, as shown in Figure 4A. The first surface 404 of the rigid support base 402 is adapted to receive the other components of the electrostatic chuck. The second surface 406 of the rigid support base 402 is adapted to be disposed on a pedestal, such as the pedestal 202 depicted in Figure 2, to form a substrate support assembly. As discussed above, the rigid support base 402 may be manufactured by an insulating material to support an electrode assembly subsequently formed thereon. In one embodiment, the rigid support base 402 is manufactured from glass, aluminum nitride or aluminum oxide. The rigid support base 402 may have a plan area selected to

accommodate the size and shape of a substrate to be disposed thereon. In one example, the rigid support base 402 may be a circular shape having a diameter between about 4 inches and about 18 inches. Alternatively, the plan area may be polygonal, such as rectangular.

[0031] At step 304, an electrode assembly 412 is disposed on the first surface 404 of the rigid support base 402. Similar to the electrode assembly 106 described above with referenced to Figures 1-2, the electrode assembly 412 may include a first electrode 408 and a second electrode 410 for generating charges with different polarities when powered by a power source 414.

[0032] In one embodiment, the electrode assembly 412 may be formed by metallic bars, sheets, mesh, foils, and be pre-molded, pre-casted and pre-manufactured and placed onto the first surface 404 of the rigid support base 402 during fabrication of the electrostatic chuck. Alternatively, a metal deposition process may be performed to deposit and form the electrode assembly 412 directly on the first surface 404 of the rigid support base 402. Suitable deposition processes include PVD, CVD, plating, ink jet printing, rubber stamping, screen printing and aerosol print process. Additionally, metal paste/metal lines may be formed on the first surface 404 of the rigid support base 402. The metal paste/metal lines may initially be a liquid, paste or metal gel that may be patterned on to the substrate surface in a desired pattern, such as an array of adjacent rectangles, circles, hexagons, or other similarly shaped features to form desired electrode fingers with different configurations or dimensions on the first surface 404 of the rigid support base 402. As discussed above, the first and the second electrodes 408, 410 may each have a plurality of electrode fingers 420, 422.

[0033] At step 306, an encapsulating member 414 is disposed on the electrode assembly 412 present on the rigid support base 402, as shown in Figure 4C. The encapsulating member 414 may be a ceramic material, or a glass material. The encapsulating member 414 may be formed on the electrode assembly 412 by a chemical vapor deposition (CVD) process, PECVD process, a spin coating process, a flame coating process, aerosol deposition process, physical vapor deposition (PVD) process, immersion coating, sputtering,

thermal spraying coating (*e.g.,* plasma spraying coating), non-plasma, non-thermal assisted coating, hot isostatic pressing, cold isostatic pressing, lamination, compression molding, casting, compacting, sintering or co-sintering techniques or any suitable process to form a ceramic material or a glass material on the electrode assembly 412. In one embodiment, the ceramic material selected to fabricate the encapsulating member 414 is at least one of glass, sapphire, silicon carbide, aluminum nitride, aluminum oxide, yttrium containing materials, yttrium oxide ($Y_2O_{3)}$, yttrium-aluminum-garnet (YAG), titanium oxide (TiO), or titanium nitride (TiN). The encapsulating member 414 may have a thickness between about 0.05 mm and about 2 mm.

[0034] In one embodiment, the encapsulating member 414 may have a coefficient of thermal expansion between about 2 μm/(m*K) and about 8 μm/(m*K). The encapsulating member 414 may have an enhanced heat resistance and a melting point greater than 1000 degrees Celsius. The electrostatic chuck working temperature is greater than about 600 degrees Celsius. The encapsulating member 414 may have a hardness (Vicker 1 Kgf) between about 10 GPa and about 30 GPa, a surface roughness between about 1 μ-inch and 6 μ-inch, such as about 4 μ-inch, and water absorbency of about less than 1 percent of less.

[0035] At step 308, a bonding process is performed to fuse both the encapsulating layer 414 and the rigid support base 402 together as a whole, forming an unitary structure, *e.g.,* a single component, of the electrostatic chuck 450, as shown in Figure 4C. In one embodiment, the bonding process may consolidate the encapsulating layer 414, the electrode assembly 412 and the rigid support base 402 to form into an integral part.

[0036] It is noted that different types of bonding processes may be utilized, such as, but not limited to annealing, sintering, adhering, slumping or diffusion bonding. In one example, the bonding process at step 308 is an annealing process. The annealing process may be performed by any suitable curing or annealing tool, such as oven, furnace, thermal plate, rapid thermal processing (RTP) chamber, spike anneal, or laser annealing chamber, and the like. The annealing process may be performed at a temperature between about 1200

degrees Celsius and about 2500 degree Celsius to assist the consolidation of the encapsulating layer 414, the electrode assembly 412 and the rigid support base 402 to form into an integral part.

[0037] Thus, an electrostatic chuck with enhanced heat resistance is provided in the present invention. The high temperature electrostatic chuck allows for greater process temperature windows and increased service life. Moreover, the ability to retain a workpiece after power has been removed from the electrodes allows chuck to be utilized in a great array of applications.

[0038] While the foregoing is directed to embodiments of the present invention, other and further embodiments of the invention 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. An electrostatic chuck comprising:

a support base;

an electrode assembly having interleaved electrode fingers formed therein; and

an encapsulating member disposed on the electrode assembly, wherein the encapsulating member is fabricated from one of a ceramic material or glass.

2. The electrostatic chuck of claim 1, wherein the ceramic material used to fabricate the encapsulating member is selected from a group consisting of glass, sapphire, silicon carbide, aluminum nitride, aluminum oxide, yttrium containing materials, yttrium oxide (Y_2O_3), yttrium-aluminum-garnet (YAG), titanium oxide (TiO), or titanium nitride (TiN).

3. The electrostatic chuck of claim 1, wherein the encapsulating member has a coefficient of thermal expansion between about 2 μm/(m*K) and about 8 μm/(m*K).

4. The electrostatic chuck of claim 1, wherein the encapsulating member has a thickness between about 0.05 mm and about 2 mm.

5. The electrostatic chuck of claim 1, wherein the electrode assembly includes a first electrode and a second electrode.

6. The electrostatic chuck of claim 5, wherein the electrode fingers extend from each of the first and the second electrodes.

7. The electrostatic chuck of claim 5, wherein the electrode fingers are segmented.

8. The electrostatic chuck of claim 1, wherein the support base is rigid.

9. The electrostatic chuck of claim 1, wherein the support base is fabricated from a ceramic or a glass material.

10. The electrostatic chuck of claim 1, wherein electrostatic chuck working temperature greater than about 600 degrees Celsius.

11. A method for fabricating an electrostatic chuck, comprising:

disposing an electrode assembly on a support base, wherein the electrode assembly includes a plurality of intervening electrode fingers; and

forming an encapsulating member on the electrode assembly, wherein the encapsulating member is fabricated from a glass or ceramic material.

12. The method of claim 11 further comprising:

bonding the support base, the electrode assembly and the encapsulating member to form an integral part.

13. The method of claim 12, wherein bonding process heats the support base, the electrode assembly and the encapsulating member to a temperature between about 1200 degrees Celsius and about 2500 degrees Celsius.

14. The method of claim 11, wherein the electrode assembly comprises at least two independently bias able electrodes.

15. An electrostatic chuck, comprising:

a support base fabricated from glass or a ceramic material;

an electrode assembly disposed on the support base, wherein the electrode assembly has at least two independently bias able electrodes having a plurality of interleaving electrode fingers formed therein; and

an encapsulating member disposed on the electrode assembly, the encapsulating member fabricated from a glass or ceramic material having a

coefficient of thermal expansion substantially matching the coefficient of thermal expansion of a material forming the electrode assembly.

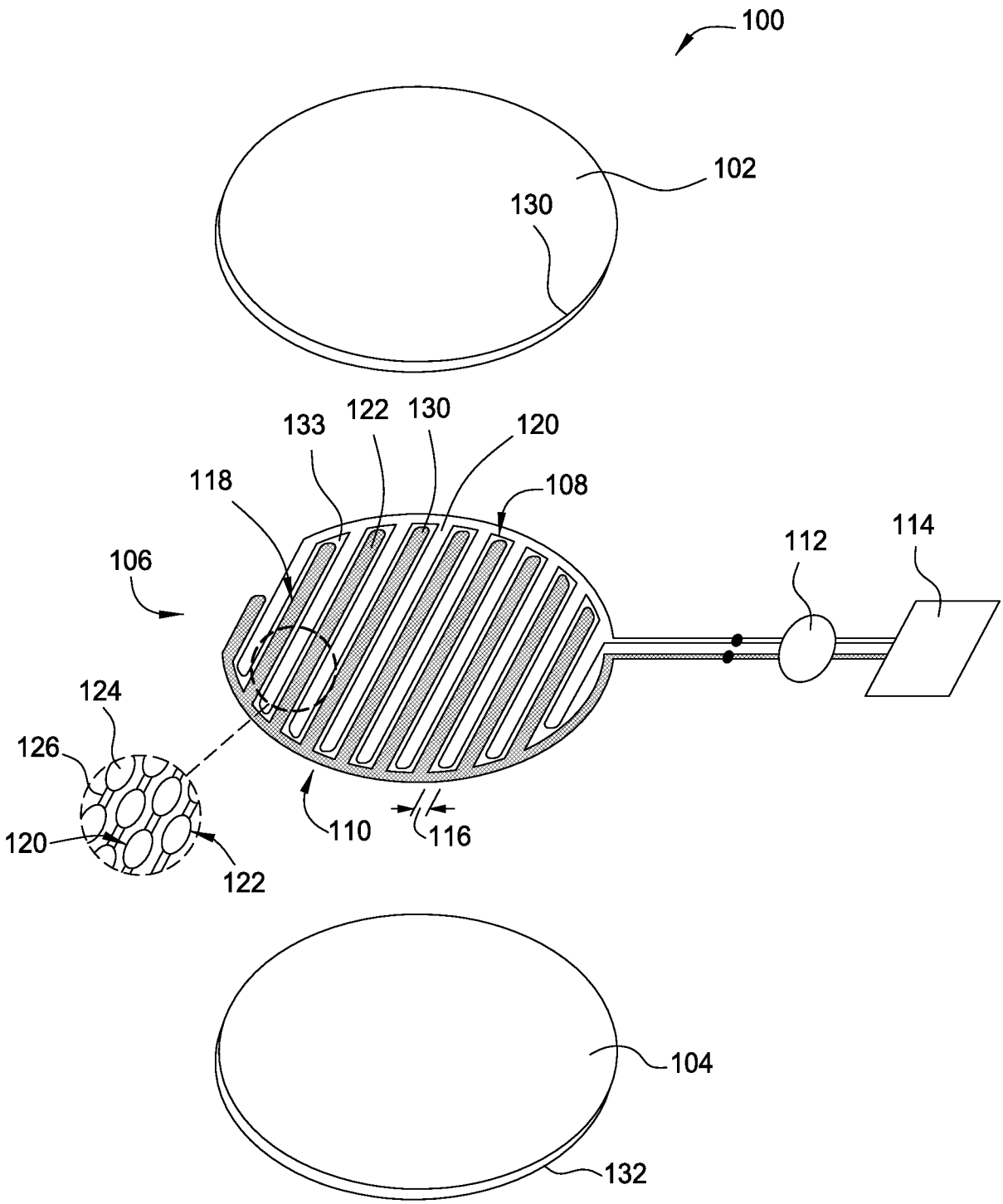

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FIG. 1

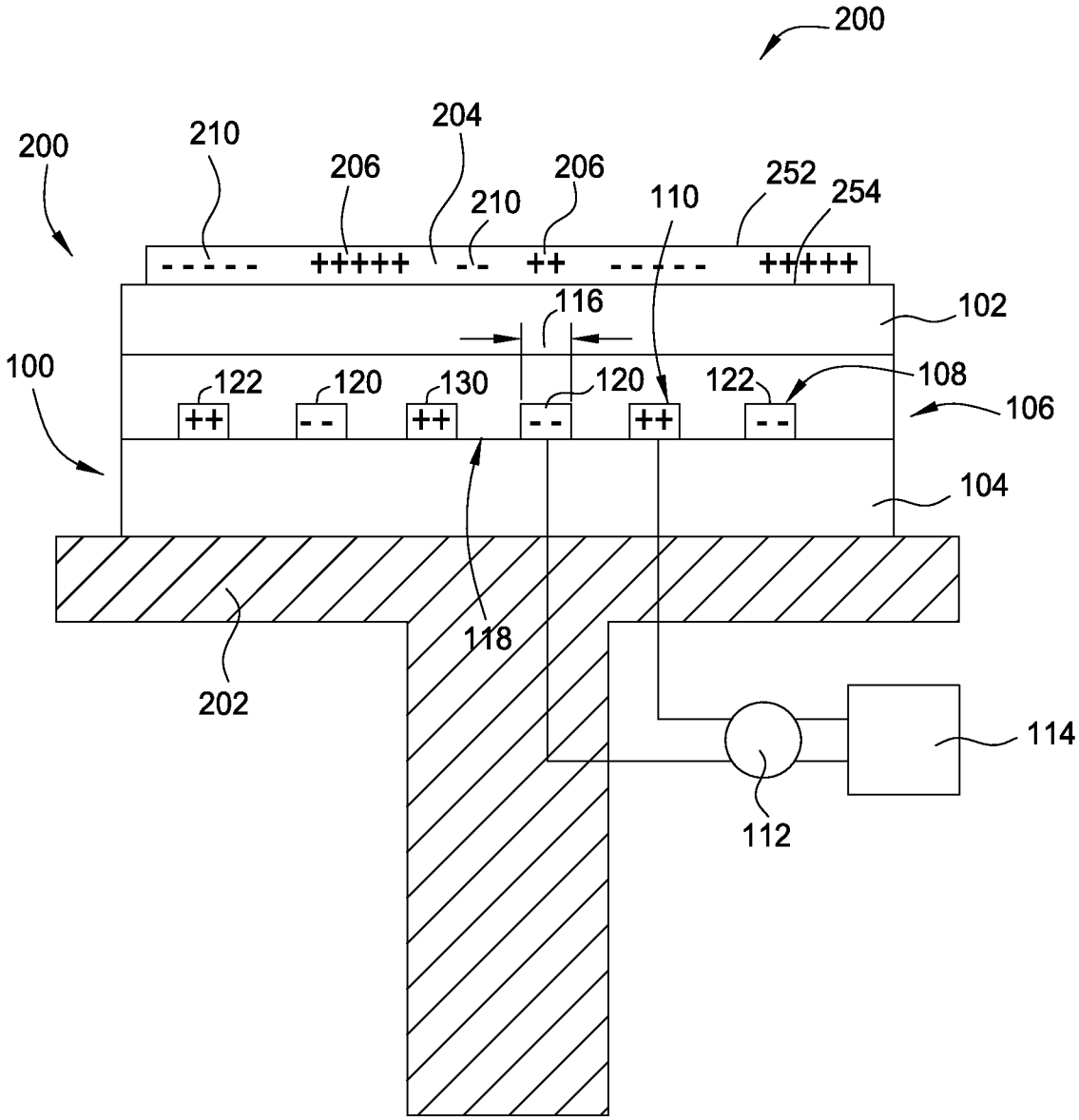

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FIG. 2

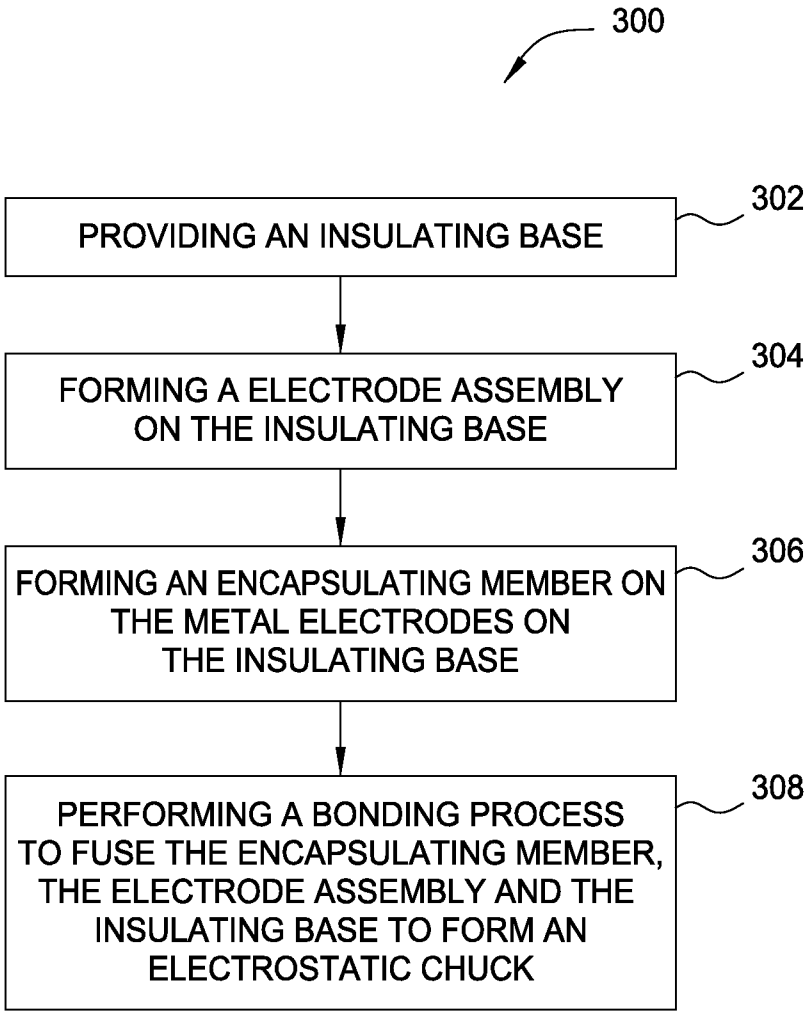

300
PROVIDING AN INSULATING BASE
302
FORMING A ELECTRODE ASSEMBLY ON THE INSULATING BASE
304
FORMING AN ENCAPSULATING MEMBER ON THE METAL ELECTRODES ON THE INSULATING BASE
306
PERFORMING A BONDING PROCESS TO FUSE THE ENCAPSULATING MEMBER, THE ELECTRODE ASSEMBLY AND THE INSULATING BASE TO FORM AN ELECTROSTATIC CHUCK
308

FIG. 3

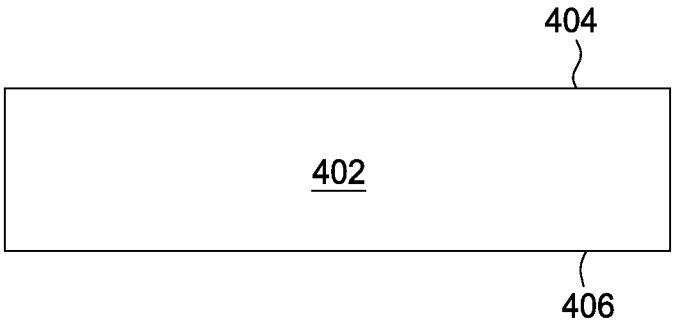


FIG. 4A

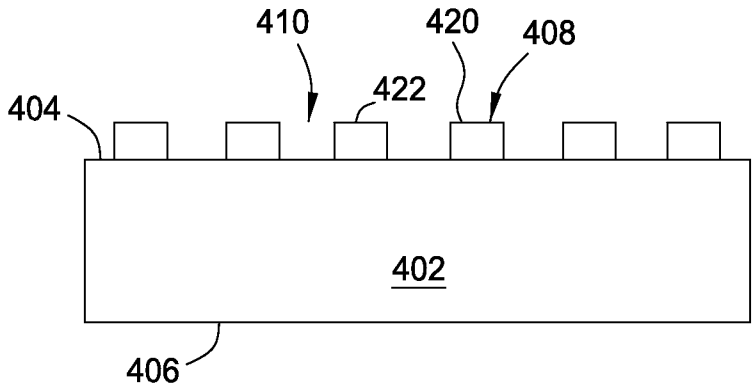


FIG. 4B

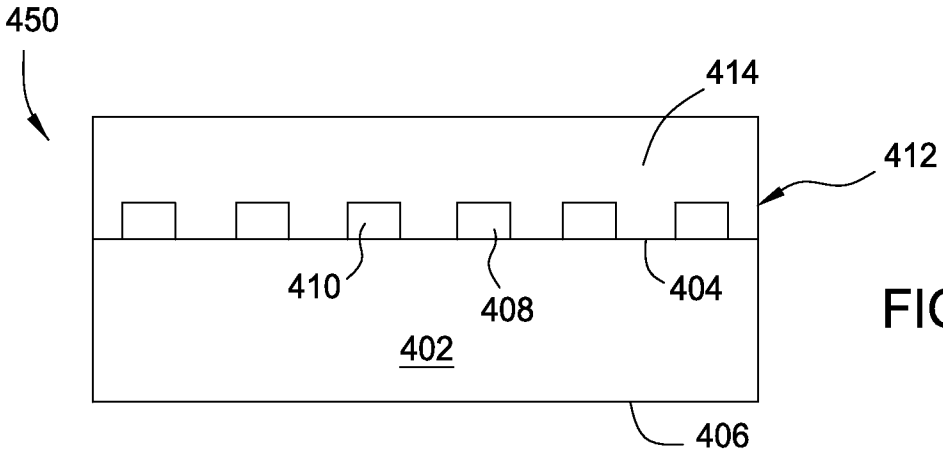


FIG. 4C

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/047291

A. CLASSIFICATION OF SUBJECT MATTER

H01L 21/683(2006.01)i, H02N 13/00(2006.01)i, B23Q 3/15(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01L 21/683; H01L 21/68; H02N 13/00; H01L 21/205; C23C 14/34; C23C 16/458; B23Q 3/15

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & keywords: electrostatic chuck, high temperature, support base, electrode assembly, interleaved electrode fingers, and encapsulating member

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 04-237148 A (FUJI ELECTRIC CO., LTD.) 25 August 1992 See abstract, paragraph [0017], and figure 1.	1,4-9,11,14
Y		2-3,10,12-13,15
Y	US 6120661 A (HIRANO et al.) 19 September 2000 See column 11, lines 21-26, column 12, lines 5-8, column 31, lines 31-36, claims 1,9, and figure 1A.	2-3,10
Y	JP 2008-028297 A (ZAIKEN: K.K.) 07 February 2008 See paragraph [0014], claim 1, and figures 1,3.	12-13
Y	JP 2004-260088 A (TAIHEIYO CEMENT CORP.) 16 September 2004 See paragraphs [0013],[0025] and figure 1.	15
A	JP 2008-244147 A (TAIHEIYO CEMENT CORP.) 09 October 2008 See abstract, paragraph [0014], and figures 1-2.	1-15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05 November 2014 (05.11.2014)	**05 November 2014 (05.11.2014)**

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2014/047291

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 04-237148A	25/08/1992	JP 3095790 B2	10/10/2000
US 6120661 A	19/09/2000	JP 11-354504 A KR 10-0539626 B1	24/12/1999 28/12/2005
JP 2008-028297 A	07/02/2008	None	
JP 2004-260088 A	16/09/2004	None	
JP 2008-244147 A	09/10/2008	None	