

PLASMA REACTOR INCLUDING PLURAL ELECTRODE ASSEMBLIES OR INTO WHICH GAS IS INJECTED

TECHNICAL FIELD

[0001] The present disclosure relates to a plasma reactor including plural electrode assemblies or a plasma reactor into which gas is injected.

BACKGROUND ART

[0002] Conventional plasma reactor uses one electrode assembly rounding up a dielectric.

[0003] Accordingly, a power should be cut off when a problem occurs to the electrode assembly, and thus plasma reaction can't be performed. As a result, pollutant inputted from a process chamber may flow to a vacuum pump.

[0004] Additionally, a problem occurs in that conductive material is adhered to an internal surface of the plasma reactor and so the electrode is electrically connected to a ground.

DISCLOSURE

TECHNICAL PROBLEM

[0005] To solve problem of the convention technique, the invention is to provide a plasma reactor including plural electrode assemblies.

[0006] Furthermore, the invention is to provide a plasma reactor for insulating between an electrode and a ground by injecting gas.

TECHNICAL SOLUTION

[0007] A plasma reactor according to one embodiment of the invention includes a body; and plural electrode assemblies formed with separated on the body. Here, the electrode assembly includes a dielectric formed on the body and an electrode formed on the dielectric, and plasma reaction is generated by applying a power to the electrodes of the electrodes assemblies, thereby decomposing pollutant flowing through the body.

[0008] A plasma reactor according to another embodiment of the invention includes a body configured to operate as a ground, gas inputted from a process chamber flowing through the body; an electrode formed on the body; and a ground formed in the body. Here, electric field is generated between the electrode and the ground according as a power is applied to the electrode, and the gas is decomposed by the electric field.

[0009] A plasma reactor according to still another embodiment of the invention includes a body configured to operate as a ground; a dielectric disposed on at least partial of the body; and an electrode disposed on the dielectric. Here, an internal space of the plasma reactor formed by at least one of the body and the dielectric is in vacuum atmosphere, and gas is injected into the internal space of the plasma reactor in vacuum atmosphere, thereby changing conductive material to an insulating material, preventing

material from adhered to an internal surface of the plasma reactor or cleaning the internal surface.

[0010] A plasma reactor according to still another embodiment of the invention includes a body; at least one electrode assembly configured to have a dielectric and an electrode disposed on the dielectric, at least partial of the dielectric being disposed on the body; and a pressure sensor configured to monitor environment of the electrode assembly.

[0011]

[0012] A plasma reactor of the present invention uses plural electrode assemblies, thereby enhancing lifetime and performance of the plasma reactor.

[0013] Moreover, gas is injected into the plasma reactor, and thus a phenomenon, that conductive material connects electrically an electrode to a ground, may be prevented. That is, the electrode and the ground may be insulated.

BRIEF DESCRIPTION OF DRAWINGS

[0014] FIG. 1 is a view illustrating schematically a process system according to one embodiment of the invention;

[0015] FIG. 2 is a perspective view illustrating a plasma reactor according to a first embodiment of the invention;

[0016] FIG. 3 is a view illustrating flux of electric field in the plasma reactor in FIG. 2;

[0017] FIG. 4 is a view illustrating flow of pollutant in the plasma reactor in FIG. 2;

[0018] FIG. 5 is a sectional view illustrating a plasma reactor according to another embodiment of the invention;

[0019] FIG. 6 is a view illustrating flow of plasma discharge in the plasma reactor in FIG. 5;

[0020] FIG. 7 is a view illustrating flow of pollutant in the plasma reactor in FIG. 5;

[0021] FIG. 8 is a view illustrating flow of electric field in a plasma reactor according to another embodiment of the invention;

[0022] FIG. 9 is a view illustrating flow of the pollutant in the plasma reactor in FIG. 8;

[0023] FIG. 10 is a view illustrating a plasma reactor according to still another embodiment of the invention;

[0024] FIG. 11 is a view illustrating injection of gas;

[0025] FIG. 12 is a view illustrating a gas injection structure according to one embodiment of the invention;

[0026] FIG. 13 and FIG. 14 are views illustrating enlarged structure of “A” in FIG. 10;

[0027] FIG. 15 is a view illustrating a plasma reactor according to still another embodiment of the invention;

[0028] FIG. 16 is a view illustrating a plasma reactor according to still another embodiment of the invention.

DETAILED DESCRIPTION

[0029] In the present specification, an expression used in the singular encompasses the expression of the plural, unless it has a clearly different meaning in the context. In the present specification, terms such as “comprising” or “including,” etc., should not be interpreted as meaning that all of the elements or operations are necessarily included. That is, some of the elements or operations may not be included, while other additional elements or operations may be further included. Also, terms such as “unit,” “module,” etc., as used in the present specification may refer to a part for processing at least one function or action and may be implemented as hardware, software, or a combination of hardware and software.

[0030]

[0031] The present invention relates to a plasma reactor capable of decomposing pollutant by using plural electrode assemblies.

[0032] In conventional plasma reactor, one electrode assembly is formed on a body. Accordingly, a power supplied to the electrode assembly is cut off when a problem occurs to the electrode assembly, and thus plasma reaction is not generated. As a result, a problem exists in that pollutant inputted from a process chamber flows into a vacuum pump.

[0033] In the plasma reactor of the invention, plural electrode assemblies are formed on a body, and so plasma reaction generates continuously by normal electrode assembly though a problem occurs to a part of the electrode assemblies. Accordingly, pollutant may not be inflowed to the vacuum pump.

[0034] In another embodiment, the plasma reactor of the invention may have a structure for preventing a blockage of an inlet. For example, a ground for keeping

plasma in the plasma reactor may be formed near the inlet of the plasma reactor.

[0035] In still another embodiment, the plasma reactor of the invention may convert internal conductive material into an insulation material, prevent pollutant from deposited on its inner surface or clean the inner surface, by injecting gas into the plasma reactor.

[0036] In still another embodiment, the plasma reactor of the invention may have a structure for keeping vacuum atmosphere and preventing external leakage of gas though a dielectric is broken down.

[0037] In still another embodiment, the plasma reactor of the invention may monitor internal environmental state by using a pressure sensor.

[0038]

[0039] Hereinafter, various embodiments of the invention will be described in detail with reference to accompanying drawings.

[0040] FIG. 1 is a view illustrating schematically a process system according to one embodiment of the invention.

[0041] In FIG. 1, the process system of the present embodiment may include a process chamber 102, a plasma reactor 100 and a vacuum pump 104. The process chamber 102 and the plasma reactor 100 may be connected through a first vacuum pipe 110, and the plasma reactor 100 and the vacuum pump 104 may be connected via a second vacuum pipe 112.

[0042] On the other hand, the plasma reactor 100 may not locate between the process chamber 102 and the vacuum pump 104, and it may be established between the vacuum pump 104 and a scrubber or on an upper part of the scrubber. Furthermore, plural plasma reactors may be set at various locations between two elements selected from a group including the process chamber, the vacuum pipe, the vacuum pump and the

scrubber. That is, the location of the plasma reactor 100 is not limited as long as the plasma reactor 100 decomposes pollutant by using plasma reaction.

[0043] Hereinafter, it is assumed that the plasma reactor 100 locates between the process chamber 102 and the vacuum pump 104, for convenience of description.

[0044] The process chamber 102 may perform an evaporation process, an etching process or a cleaning process, etc. in a vacuum atmosphere. Here, gas, etc. used in the process chamber 102 varies depending on the process.

[0045] As a result, an exhaust gas including a precursor, process gas, cleaning gas or by-product is inputted from the process chamber 102 to the plasma reactor 100 through a first vacuum pipe 110. That is, pollutant is inputted from the process chamber 102 to the plasma reactor 100.

[0046] The pollutant may block the inside of a pipe as it is deposited on an internal surface of the pipe. Additionally, temperature condition and pressure condition in the vacuum pump 104 may change sharply when the pollutant is inputted to the vacuum pump 104, and thus the pollutant may be solidified or liquidized in the vacuum pump 104 according as phase of the pollutant is changed. Specifically, it raises serious problem if the pollutant is released into the atmosphere.

[0047] Accordingly, the plasma reactor 100 for removing the pollutant may be set between the process chamber 102 and the vacuum pump 104.

[0048] The plasma reactor 100 removes the pollutant by decomposing the inputted pollutant. Particularly, The plasma reactor 100 generates electric field using an electrode, and the pollutant may be decomposed through plasma reaction due to the electric field.

[0049] Here, the plasma reaction may not be generated in the plasma reactor 100, when the electrode is broken down. As a result, the pollutant inputted from the

process chamber 102 may be inputted to the vacuum pump 104.

[0050] Accordingly, the plasma reactor 100 of the present embodiment uses plural electrodes not one electrode. Accordingly, the other electrodes operate normally though a part of the electrodes is broken down, thereby decomposing and removing continuously the pollutant. As a result, lifetime of the plasma reactor 100 may be extended and performance of the plasma reactor 100 may be enhanced.

[0051] Hereinafter, various embodiment of the plasma reactor 100 will be described in detail.

[0052] FIG. 2 is a perspective view illustrating a plasma reactor according to a first embodiment of the invention, FIG. 3 is a view illustrating flux of electric field in the plasma reactor in FIG. 2, and FIG. 4 is a view illustrating flow of pollutant in the plasma reactor in FIG. 2.

[0053] In FIG. 2 to FIG. 4, the plasma reactor 100 of the present embodiment may include a body 200, plural electrode assemblies 202a, 202b, 202c and 202d, an inlet 210 and an outlet 212. Additionally, the plasma reactor 100 may include further a ground 204 formed through the body 200.

[0054] The body 200 is a housing, pollutant flowing through the body 200. In one embodiment, the body 200 may operate as a ground.

[0055] The electrode assembly 202 may be formed on partial surface of the body 200 and include a dielectric 300 formed on the body 20 and an electrode 302 formed on the dielectric 300. Here, a positive voltage may be applied to the electrode 302. As a result, electric field may be generated between the electrode 302 and the body 200 operating as the ground as shown in FIG. 3, plasma reaction may be generated by the electric field, and so the pollutant may be removed by decomposed.

[0056] Particularly, the pollutant inputted through the inlet 210 flows through a space

between the body 200 and the ground 204 as shown in FIG. 4, and the pollutant may flow to the vacuum pump 104 through the outlet 212.

[0057] The electric field is generated when the positive voltage is applied to the electrode 302 while the pollutant flows in the body 200, thereby generating the plasma reaction. The pollutant may be decomposed and removed by the plasma reaction. For example, gas is ionized, and by-product may be decomposed as ion reacts to the by-product.

[0058] In one embodiment, two or more electrode assemblies 202, e.g. four electrode assemblies 202a, 202b, 202c and 202d may be formed with separated on the body 200.

[0059] For example, the body 200 may have a hexagonal shape as shown in FIG. 3, and the electrode assemblies 202a, 202b, 202c or 202d may be formed on four surfaces of six surfaces, respectively. Particularly, a first electrode assembly 202a and a second electrode assembly 202b may be respectively formed with separated on two right surfaces of the body 200, and a third electrode assembly 202c and a fourth electrode assembly 202d may be respectively formed with separated on two left surfaces of the body 200.

[0060] If only one electrode is formed on the body 200, pollutant may flow to the vacuum pump 104 through the body 200 when the electrode does not operate normally due to breakdown of the dielectric or the electrode and so on. Accordingly, operation of the plasma reactor should be immediately stopped, i.e. a power applied to the electrode should be cut off.

[0061] If the electrode assemblies 202 are formed on the body 200, the other electrode assemblies 202 operate normally though a part of the electrode assemblies 202 does not operate normally, thereby removing continuously the pollutant. That is, lifetime of the plasma reactor 100 may be extended.

[0062] In one embodiment, power may be applied to the electrode assemblies 202, respectively. Here, the power may be sub power divided from one power source.

[0063] Stronger power is applied to an electrode assembly operating normally when a part of the electrode assemblies 202 does not operate normally, and thus plasma density may be increased. In this time, a power applied to an electrode of the electrode assembly not operating normally may be cut off. As a result, removal efficiency of pollutant when a part of the electrode assemblies 202 does not operate normally may be similar to that when every electrode assembly 202 operates normally.

[0064] In one embodiment, the ground 204 may be formed through a central part of the body 200, and so at least partial of the ground 204 is disposed in the body 200. This ground 204 may minimize interference between the electrodes, thereby stabilizing plasma reaction. That is, the plasma reaction may be stabilized because interference between electric fields generated by the electrode is minimized by the ground 204.

[0065] Amount of plasma progressed to the inlet may be minimized by the ground 204 because the electric field progresses toward the central part not the inlet due to the ground 204 as shown in FIG. 3. If the plasma progresses toward the inlet, the pollutant is not perfectly removed because plasma density of the inlet is low. As a result, a solid is generated, and so the inlet or a pipe connected to the inlet may be blocked. Affection of the electric field about the inlet may be minimized by using the ground 204, and thus blocking of the inlet or the pipe may be prevented.

[0066] Furthermore, the ground 204 may function as an antenna.

[0067] The ground 204 may not be used because the body 200 operates as the ground. Or, the body 200 may not perform function of the ground if the ground 204 exists. It is efficient that the body 200 operates as the ground and the ground 204 is formed inside the body 200, considering decomposition efficiency of the pollutant, etc.

[0068] In one embodiment, the ground 204 may be cylindrically rolled up, and thus it faces to the electrode assemblies 202a, 202b, 202c and 202d.

[0069] Briefly, the electrode assemblies 200 are disposed with separated on a surface of the body 200, and the ground 204 may be further formed inside the body 200.

[0070] FIG. 5 is a sectional view illustrating a plasma reactor according to another embodiment of the invention, FIG. 6 is a view illustrating flow of plasma discharge in the plasma reactor in FIG. 5, and FIG. 7 is a view illustrating flow of pollutant in the plasma reactor in FIG. 5.

[0071] In FIG. 5, the plasma reactor of the present embodiment may include a body 500, plural electrode assemblies 502a, 502b, 502c and 502d formed on the body 500, an inlet buffer chamber 510, an outlet buffer chamber 512 and a ground 520.

[0072] In one embodiment, the body 500 may have rectangular shape, and electrode assemblies 502 may be formed on surfaces of the body 500, respectively. Four electrode assemblies 502a, 502b, 502c and 502d are formed in FIG. 5. However, it is sufficient that two or more electrode assemblies are formed with separated.

[0073] The electrode assembly 502 may include a dielectric 530 formed on the body 500 and an electrode 532, e.g. high voltage electrode formed on the dielectric 530. For example, a positive voltage may be applied to the electrode 532.

[0074] In one embodiment, since the body 500 functions as the ground, electric field is generated between the electrodes 532 and the body 500 according as a positive voltage is applied to the electrodes 532 as shown in FIG. 6, thereby generating plasma reaction. As a result, pollutant inputted from the process chamber 102 through an inlet 510 may be decomposed, and so the pollutant may be removed. For example, gas is ionized, and by-product may be decomposed according as ions react to the by-product.

[0075] If the ground 520 is not formed in the inlet buffer chamber 510, the electric

field affects to the inlet or inside a pipe, and thus plasma reaction may be generated in the inlet or the pipe. In this case, since plasma density is low, the pollutant is not perfectly removed in the inlet or the pipe. As a result, a solid is generated, and so the inlet or the pipe may be blocked. Accordingly, the plasma reactor 100 keeps the plasma therein by forming the ground 520 in the inlet buffer chamber 510, as shown in FIG. 6. As a result, the inlet or the pipe may not be blocked.

[0076] Shortly, when the pollutant inputted from the process chamber 102 flows to the plasma reactor 100 as shown in FIG. 7, the blocking of the inlet or the pipe connected to the inlet may be prevented by using the ground 520, with decomposing the pollutant through the plasma reaction in the plasma reactor 100. Here, the ground 520 may be supported by a supporting member 522.

[0077] A ground may be formed in the outlet buffer chamber 512. However, blocking of the outlet may not be occurred though the ground does not exist because the pollutant is sufficiently decomposed and removed in the plasma reactor 100. Accordingly, the ground may not be necessarily formed in the outlet buffer chamber 512.

[0078] In one embodiment, the electrode assemblies 502 separated with one another may be formed on the body 500.

[0079] In one embodiment, two or more electrode assemblies 502, e.g. four electrode assemblies 502a, 502b, 502c and 502d may be formed with separated on the body 500.

[0080] For example, the body 500 may have a rectangular shape as shown in FIG. 6, and the electrode assemblies 502a, 502b, 502c and 502d may be formed on surfaces of the body 500, respectively. Particularly, a first electrode assembly 502a, a second electrode assembly 502b, a third electrode assembly 502c and a fourth electrode assembly 502d may be disposed with separated.

[0081] In one embodiment, a power may be applied to each of the electrode assemblies 502. Here, the power may be a sub power divided from one power.

[0082] Stronger power is applied to an electrode assembly operating normally when a part of the electrode assemblies 502 does not operate normally, and thus plasma density may be increased. In this time, a power applied to an electrode of the electrode assembly not operating normally may be cut off. As a result, removal efficiency of pollutant when a part of the electrode assemblies 502 does not operate normally may be similar to that when every electrode assembly 502 operates normally.

[0083] Briefly, the electrode assemblies 502 may be formed on the body 500, and the ground 520 may be disposed in the inlet buffer chamber 510.

[0084] On the other hand, the ground 520 keeps the plasma in the plasma reactor 100, but various modifications may be realized as long as it keeps the plasma in the plasma reactor 100. A member for performing this function may be commonly referred to as a blocking member.

[0085] FIG. 8 is a view illustrating flow of electric field in a plasma reactor according to another embodiment of the invention, and FIG. 9 is a view illustrating flow of the pollutant in the plasma reactor in FIG. 8.

[0086] In FIG. 8 and FIG. 9, the plasma reactor 100 of the present embodiment may include a body 800, plural electrode assemblies 802a, 802b, 802c and 802d, an inlet 810, an outlet 812, a buffer chamber 820 and a second ground 822. Moreover, the plasma reactor 100 may include further a first ground 804 formed through the body 800.

[0087] The body 800 is a housing, pollutant flowing through the body 800. In one embodiment, the body 800 may operate as a ground.

[0088] The electrode assembly 802 may be formed on a part of the body 800 and include a dielectric 830 formed on the body 800 and an electrode 832 formed on the

dielectric 830. Here, a positive voltage may be applied to the electrode 832. As a result, electric field is generated between the electrode 832 and the body 800 operating as the ground as shown in FIG. 8, plasma reaction is generated by the electric field, and so the pollutant may be decomposed and removed.

[0089] In one embodiment, two or more electrode assemblies 802, e.g. four electrode assemblies 802a, 802b, 802c and 802d may be disposed with separated on the body 800.

[0090] In one embodiment, the first ground 804 may be formed through a central part of the body 800, and thus at least partial of the first ground 804 may be disposed in the body 800. The first ground 804 may stabilize plasma reaction by minimizing interference between the electrodes. That is, interference among electric fields due to the electrode may be minimized by the first ground 804, and so the plasma reaction may be stabilized.

[0091] In one embodiment, the first ground 804 may be cylindrically rolled up, and thus it faces to the electrode assemblies 802a, 802b, 802c and 802d.

[0092] The buffer chamber 820 is formed on the inlet 810, and the second ground 822 may be formed in the buffer chamber 820. The second ground 822 keeps plasma in the plasma reactor 100.

[0093] Shortly, the electrode assemblies 802 may be formed with separated on the body 800, the first ground 804 may be formed in the body 800, and the second ground 822 may be formed in the buffer chamber 820.

[0094] FIG. 10 is a view illustrating a plasma reactor according to still another embodiment of the invention, FIG. 11 is a view illustrating injection of gas, and FIG. 12 is a view illustrating a gas injection structure according to one embodiment of the invention. FIG. 13 and FIG. 14 are views illustrating enlarged structure of “A” in FIG. 10.

[0095] As shown in FIG. 11, gas 1100 may be injected in the plasma reactor. A structure for injecting the gas 1100 is shown in FIG. 12. As shown in FIG. 12, the gas 1100 may be injected at multiple points.

[0096] Referring to “A” part, which is an outer surface of the plasma reactor, through FIG. 12, the plasma reactor may include a ground (body) 1200, a safety cover 1202, a dielectric 1204, an electrode 1206, an insulator 1208, an insulating and heat conductive sheet 1210 and a gas injection hole 1212.

[0097] A part of the dielectric 1204 is formed on the ground 1200, and the other part of the dielectric 1204 is exposed in an internal space of the plasma reactor.

[0098] The electrode 1206 is formed on the dielectric 1204.

[0099] The insulator 1208 is formed on the electrode 1206, and the insulating and heat conductive sheet 1210 is formed on the insulator 1208.

[00100] The safety cover 1202 covers the ground 1200, a part of the dielectric 1204 and the insulating and heat conductive sheet 1210, and it may prevent a phenomenon that vacuum atmosphere of the plasma reactor is broken or internal pollutant is leaked outside.

[00101] The gas injection hole 1212 is formed through the safety cover 1202, and thus the gas flows inside the safety cover 1202 through the gas injection hole 1212. Subsequently, the gas may be injected to in the plasma reactor through a space between the ground 1200 and the dielectric 1204. In this case, an injection nozzle 1220 may be formed at the space between the ground 1200 and the dielectric 1204, and the gas may be injected in the plasma reactor through the injection nozzle 1220.

[00102] A method of injecting the gas may be variously modified as long as the gas flow through the gas injection hole 1212 and then the gas is injected in the plasma reactor through the space between the ground 1200 and the dielectric 1204.

[00103] In one embodiment, a gas for removing conductive material by changing the conductive material in the plasma reactor into an insulating material may be injected in the plasma reactor. The ground 1200 and the electrode 1206 are electrically separated by the dielectric 1204, but a problem may exist in that the ground 1200 and the electrode 1206 are electrically connected by the conductive material in the plasma reactor. Accordingly, it is necessary to change the conductive material into the insulating material. The plasma reactor may solve the problem that the ground 1200 and the electrode 1206 are electrically connected, by injecting outer gas into the plasma reactor to change the conductive material into the insulating material. On the other hand, the conductive material may be a material inputted from the process chamber 102 or a material generated by the plasma reaction.

[00104] In another embodiment, partial pressure of an area or environmental area into which the gas is injected in the plasma reactor increases, and thus the pollutant may not be deposited on an internal surface of the plasma reactor.

[00105] In still another embodiment, cleaning gas may be injected into the plasma reactor so that the internal surface of the plasma reactor is cleaned before coated conductive material reaches an insulating broken thickness.

[00106] That is, kind and effect of the gas may vary depending on usage purpose.

[00107] In above description, the gas is injected in the plasma reactor through the space between the ground 1200 and the dielectric 1204. However, injection location and structure of the gas may be variously modified as long as the gas is injected into the plasma reactor.

[00108] In FIG. 13, the plasma reactor of the present embodiment may include the ground 1200, the safety cover 1202, the dielectric 1204, the electrode 1206, the insulator 1208, the insulating and heat conductive sheet 1210, a home 1300 and a home

1302. Here, the home 1300 is formed on an internal surface of the safety cover 1202 and a first ring is inserted into the home 1300. Additionally, the home 1302 is formed on the internal surface of the safety cover 1202 and a second ring is inserted into the home 1302.

[00109] Since the other elements except the first ring and the second ring are the same as in FIG. 11, any further description concerning the same elements will be omitted.

[00110] The first ring may prevent a phenomenon that gas inputted into the plasma reactor is inputted to a space of the electrode assembly.

[00111] The second ring is used for keeping vacuum atmosphere when the dielectric 1204 is broken down. If the dielectric 1204 is broken down, vacuum atmosphere may be broken according as air is inputted into the plasma reactor. Accordingly, the second ring may be set over whole of the body so that air is not inputted into the plasma reactor, though the dielectric 1204 is broken down.

[00112] In one embodiment, the second ring may be set on a point at which the dielectric 1204 and the safety cover 102 meet.

[00113] Furthermore, the second ring may prevent gas injected into the plasma reactor from leaked outside.

[00114] Location, number, size, etc. of the first ring and the second ring are not limited as long as the first ring and the second ring prevent the gas from inputted to the electrode assembly and prevent breakdown of vacuum atmosphere.

[00115] In FIG. 14, the plasma reactor of the present embodiment may include the ground 1200, the safety cover 1202, the dielectric 1204, at least one electrode assembly having the dielectric 1204 and the electrode 1206, an insulating section 1400, a closed space 1402 for closing the electrode assembly and a pressure sensor 1410.

[00116] The electrode assembly of the plasma reactor is closed, and the pressure sensor

1410 may monitor environmental condition of the electrode assembly.

[00117] For example, the pressure sensor 1410 may monitor temperature by setting pressure upper limit range, and stop a power applied to an electrode of the electrode assembly when temperature goes up more than preset value. This is because a problem occurs to power supplement if the temperature goes up more than preset value.

[00118] For another example, the pressure sensor 1410 may monitor breakdown of the dielectric 1204 by setting pressure lower limit range, and turn off a power applied to the electrode when it is discriminated that the dielectric 1204 is broken down. This is because vacuum atmosphere is broken when the dielectric 1204 is broken down.

[00119] That is, the plasma reactor may monitor environment (temperature, breakdown of the dielectric) of the electrode assembly by using the pressure sensor 1410. Location and number of the pressure sensor 1410 are not limited as long as the pressure sensor 1410 monitors the environment of the electrode assembly.

[00120] FIG. 15 is a view illustrating a plasma reactor according to still another embodiment of the invention.

[00121] In FIG. 15, the plasma reactor of the present embodiment may include a body 1500, electrodes 1502a and 1502b, an inlet 1510 and plural outlets 1512, 1514 and 1516. Here, the outlets 1512, 1514 and 1516 may be connected to vacuum pumps, respectively.

[00122] One outlet 212 and one vacuum pump 104 exist in FIG. 2, and thus capacity of the vacuum pump 104 is lack. Whereas, the plasma reactor of the present embodiment may secure enough capacity because it uses plural vacuum pumps.

[00123] On the other hand, plural electrode assemblies 1502a and 1502b may be formed on the body 1500 though the plasma reactor includes the outlets 1512, 1514 and 1516. Outlets 1514 and 1516 are formed instead of the electrode assemblies 202b and

202c in FIG. 2.

[00124] FIG. 16 is a view illustrating a plasma reactor according to still another embodiment of the invention.

[00125] Referring to (A) and (B) in FIG. 16, the plasma reactor of the present embodiment may include a body 1600 and plural electrode assemblies 1602a, 1602b, 1602c and 1602d formed on the body 1600. The plasma reactor may include further a buffer chamber 1614 located between an inlet 1610 and the body 1600 and a buffer chamber 1616 located between an outlet 1612 and the body 1600.

[00126] The body 200 has hexagonal shape in FIG. 2, and the body 1600 in the present embodiment has a rectangular shape. Plural electrode assemblies may be formed on surfaces irrespective of polygonal shape. Of course, electrode assemblies may be formed with separated on a cylindrical body. That is, location and number of the electrode assemblies are not limited as long as the electrode assemblies are formed on an outer surface of the body.

[00127]

[00128] Components in the embodiments described above can be easily understood from the perspective of processes. That is, each component can also be understood as an individual process. Likewise, processes in the embodiments described above can be easily understood from the perspective of components.

[00129] Various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

[00130]

CLAIMS

1. A plasma reactor comprising:
a body; and
plural electrode assemblies formed with separated on the body,
wherein the electrode assembly includes a dielectric formed on the body and an electrode formed on the dielectric, and plasma reaction is generated by applying a power to the electrodes of the electrodes assemblies, thereby decomposing pollutant flowing through the body.
2. The plasma reactor of claim 1, wherein the body functions as a ground, and the pollutant is decomposed and removed by electric field generated between the electrodes and the ground.
3. The plasma reactor of claim 2, wherein additional ground for minimizing interference among electric fields generated by the electrode assemblies is formed at an internal central part of the body, and the electrode assemblies are disposed toward the additional ground with located between the inlet and the additional ground so that electric field by the electrode assemblies and the additional ground is not progressed to the inlet through which the pollutant is inputted, thereby preventing progress of plasma to the inlet.
4. The plasma reactor of claim 1, wherein higher power is applied to an electrode assembly operating normally when a part of the electrode assemblies does not operate normally.

5. The plasma reactor of claim 1, wherein plural outlets are formed at the body, and the outlets are connected to vacuum pumps, respectively.

6. The plasma reactor of claim 1, wherein the body has a polyhedral shape, and the electrode assemblies are disposed with separated on surfaces of the body.

7. A plasma reactor comprising:
a body configured to operate as a ground, gas inputted from a process chamber flowing through the body;
an electrode assembly formed on the body; and
a ground formed in the body,
wherein electric field is generated between the electrode and the ground according as a power is applied to the electrode, and the gas is decomposed by the electric field.

8. A plasma reactor comprising:
a body configured to operate as a ground;
a dielectric disposed on at least partial of the body; and
an electrode disposed on the dielectric,
wherein an internal space of the plasma reactor formed by at least one of the body and the dielectric is in vacuum atmosphere, and gas is injected into the internal space of the plasma reactor in vacuum atmosphere, thereby changing conductive material to an insulating material, preventing material from adhered to an internal surface of the plasma reactor or cleaning the internal surface.

9. The plasma reactor of claim 8, wherein the gas is injected to the internal space of the plasma reactor through a space between the body and the dielectric.

10. The plasma reactor of claim 8, further comprising:
a safety cover configured to cover the body, the dielectric and the electrode,
wherein the gas is inputted to a space passing through the safety cover and then the gas is injected to the internal space through the space between the body and the dielectric.

11. The plasma reactor of claim 9, wherein a nozzle for injecting the gas to the internal space is formed at the space between the body and the dielectric.

12. The plasma reactor of claim 8, wherein kind of the gas varies depending on gas injection purpose.

13. The plasma reactor of claim 8, further comprising:
a safety cover configured to cover the body, the dielectric and the electrode,
wherein a first home and a second home are formed with separated on an internal surface of the safety cover, a first ring is inserted into the first home, a second ring is inserted into the second home,

the first ring prevents a phenomenon the injected gas is inputted to the electrode assembly of the plasma reactor, and the second ring prevents a phenomenon that the vacuum atmosphere is broken and the injected gas is leaked outside the plasma reactor when the dielectric is broken down.

14. A plasma reactor comprising:

a body;

at least one electrode assembly configured to have a dielectric and an electrode disposed on the dielectric, at least partial of the dielectric being disposed on the body;
and

a pressure sensor configured to monitor environment of the electrode assembly.

15. The plasma reactor of claim 14, wherein the pressure sensor monitors temperature of the electrode assembly by setting a pressure upper limit range and monitor breakdown of the dielectric by setting a pressure lower limit range,

and wherein power supplying to the electrode is stopped when temperature of the electrode assembly is higher than a preset value or the dielectric is broken down.