

# US Patent & Trademark Office

## Patent Public Search | Text View

---

United States Patent	12394640
Kind Code	B2
Date of Patent	August 19, 2025
Inventor(s)	Park; Hyojin et al.

---

### Apparatus for cleaning wafer

---

#### Abstract

A wafer cleaning apparatus includes a base, a roller installation table installed on the base, a wafer support unit disposed at the roller installation table and having a support roller for rotatably supporting an edge of a wafer, a pressing roller installed on the roller installation table and above the wafer support unit, and configured to press opposite surfaces of the wafer, and a driving unit providing a force in a direction, crossing a direction of a central axis of the pressing roller, so that a shape of the pressing roller is deformed. The pressing roller deformed by the driving unit applies a first pressure to a central portion of the wafer and a second pressure, different from the first pressure, to an edge portion of the wafer.

---

**Inventors:** Park; Hyojin (Suwon-si, KR), Kang; Songyun (Suwon-si, KR), Park; Sungyong (Suwon-si, KR), Lee; Kiseok (Suwon-si, KR)

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

**Family ID:** 1000008766949

**Assignee:** SAMSUNG ELECTRONICS CO., LTD. (Suwon-si, KR)

**Appl. No.:** 18/200619

**Filed:** May 23, 2023

#### Prior Publication Data

<b>Document Identifier</b>	<b>Publication Date</b>
US 20230402299 A1	Dec. 14, 2023

#### Foreign Application Priority Data

KR	10-2022-0070896	Jun. 10, 2022
----	-----------------	---------------

---

#### Publication Classification

**Int. Cl.:** H01L21/67 (20060101); B08B1/10 (20240101); B08B1/32 (20240101)

**U.S. Cl.:**

**CPC** H01L21/67092 (20130101); B08B1/10 (20240101); B08B1/32 (20240101);

**Field of Classification Search**

**CPC:** H01L (21/67092); B08B (1/10); B08B (1/32)

**USPC:** 134/137

**References Cited**

**U.S. PATENT DOCUMENTS**

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
8496758	12/2012	Idani	N/A	N/A
9704729	12/2016	Cho et al.	N/A	N/A

**FOREIGN PATENT DOCUMENTS**

Patent No.	Application Date	Country	CPC
1243368	12/2005	CN	N/A
112735940	12/2020	CN	N/A
6418790	12/2017	JP	N/A
6549936	12/2018	JP	N/A
1020040070593	12/2003	KR	N/A
102013693	12/2018	KR	N/A
102279523	12/2020	KR	N/A

**OTHER PUBLICATIONS**

CN112735940A—machine translation (Year: 2021). cited by examiner

*Primary Examiner:* Ayalew; Tinsae B

*Attorney, Agent or Firm:* Muir Patent Law, PLLC

**Background/Summary**

**CROSS-REFERENCE TO RELATED APPLICATION**

(1) This application claims the priority and benefit of Korean Patent Application No. 10-2022-0070896, filed on Jun. 10, 2022, with the Korean Intellectual Property Office, the inventive concept of which is herein incorporated herein by reference.

**BACKGROUND**

1. Field

(2) The present inventive concept relates to an apparatus for cleaning a wafer.

2. Description of Related Art

(3) In general, after a chemical mechanical polishing (CMP) process is performed, a surface of a wafer is highly contaminated, as compared to other processes. These contaminant particles may

interfere with electrical signal transmission of a device and cause problems in post-processing.

(4) In order to remove such contaminant particles, the wafer may be cleaned by being immersed in a chemical substance, but since it is impossible to completely clean the wafer, a physical cleaning method must be performed together therewith.

(5) However, there may be a problem in that mechanical damage such as pattern collapse, scratches, tears, and the like may occur because it is difficult to precisely control cleaning power of the physical cleaning method.

## SUMMARY

(6) An aspect of the present inventive concept is to provide an apparatus for cleaning a wafer for efficiently and precisely controlling cleaning power.

(7) According to an aspect of the present disclosure, a wafer cleaning apparatus includes a base, a roller installation table installed on the base, a wafer support unit disposed at the roller installation table and having a support roller for rotatably supporting an edge of a wafer, a pressing roller installed on the roller installation table and above the wafer support unit, and configured to press opposite surfaces of the wafer, and a driving unit providing a force in a direction, crossing a direction of a central axis of the pressing roller, so that a shape of the pressing roller is deformed. The pressing roller deformed by the driving unit applies a first pressure to a central portion of the wafer and a second pressure, different from the first pressure, to an edge portion of the wafer.

(8) According to an aspect of the present disclosure, a wafer cleaning apparatus includes a base, a roller installation table installed on the base, a wafer support unit disposed at the roller installation table and having a support roller for rotatably supporting a wafer, and a pressing roller installed on the roller installation table and above the wafer support unit, and configured to press opposite surfaces of the wafer. The pressing roller is provided with a plurality of space portions configured to apply a pneumatic pressure on the opposite surfaces of the wafer.

(9) According to an aspect of the present disclosure, a wafer cleaning apparatus includes a base, a pair of first installation plates fixed at the base and erected vertically from the base, a first pressing roller rotatably connected to the pair of first installation plates, wherein the first pressing roller extends in a first direction and the pair of first installation plates are spaced apart from each other in the first direction, a pair of second installation plates fixed at the base and erected vertically from the base, wherein the pair of second installation plates are spaced apart from the pair of first installation plates in a second direction perpendicular to the first direction, a second pressing roller rotatably connected to the pair of second installation plates, wherein the second pressing roller extends in the first direction and is spaced apart from the first pressing roller in the second direction, and a plurality of support rollers disposed between the base and a gap between the first and second pressing rollers, wherein the plurality of support rollers are controlled to rotate in a same direction.

---

## Description

### BRIEF DESCRIPTION OF DRAWINGS

(1) The above and other aspects, features, and advantages of the present inventive concept will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

(2) FIG. 1 is a schematic perspective view illustrating an apparatus for cleaning a wafer according to an example embodiment,

(3) FIG. 2 is an illustrative view illustrating a pressing roller provided in an apparatus for cleaning a wafer according to an example embodiment.

(4) FIG. 3 is a graph illustrating pressing force according to the prior art and the pressing roller illustrated in FIG. 2.

- (5) FIG. 4 is an illustrative view illustrating a pressing roller and a backup roller provided in the apparatus for cleaning a wafer according to an example embodiment.
- (6) FIGS. 5 and 6 are illustrative views illustrating a pressing roller and a backup roller provided in the apparatus for cleaning a wafer according to an example embodiment.
- (7) FIGS. 7 and 8 are illustrative views illustrating a pressing roller and a backup roller provided in the apparatus for cleaning a wafer according to an example embodiment.
- (8) FIG. 9 is a graph illustrating pressing force applied to the wafer by the pressing roller and the backup roller illustrated in FIGS. 7 and 8.
- (9) FIG. 10 is an explanatory diagram illustrating a pressing roller provided in the apparatus for cleaning a wafer according to an example embodiment.

#### DETAILED DESCRIPTION

- (10) Hereinafter, example embodiments of the present inventive concept will be described with reference to the accompanying drawings as follows.
- (11) FIG. 1 is a schematic perspective view illustrating an apparatus for cleaning a wafer according to an example embodiment, and FIG. 2 is an illustrative view illustrating a pressing roller provided in an apparatus for cleaning a wafer according to an example embodiment.
- (12) Referring to FIGS. 1 and 2, an apparatus for cleaning a wafer **100** (i.e., a wafer cleaning apparatus) according to an example embodiment includes a base **110**, a roller installation table **120**, a wafer support unit **130**, a pressing roller **140**, and a driving unit **150** (i.e., a pressing roller driver).
- (13) The base **110** has, for example, a substantially rectangular plate shape. A roller installation table **120**, a wafer support unit **130**, and the like may be installed on an upper surface of the base **110**. Meanwhile, a rotation driving unit **112** for rotation of a wafer **W** may be provided at one end of an upper surface of the base **110**. The rotation driving unit **112** serves to rotate the wafer **W** when the wafer **W** is cleaned. To this end, the rotation driving unit **112** may be connected to a support roller **132** of the wafer support unit **130** to be described later.
- (14) The roller installation table **120** is installed on the upper surface of the base **110**. As an example, the roller installation table **120** may be disposed adjacent to one side of the rotation driving unit **112**. Meanwhile, the roller installation table **120** may be provided with an installation plate **122** having a predetermined height from the base **110** upwardly in order to install the pressing roller **140**. In other words, two pairs of installation plates **122** on which opposite ends of the pressing roller **140** are installed may be disposed on opposite sides of the pressing roller **140** on the roller installation table **120**. In some embodiments, the pressing roller **140** may include two pairs of installation plates **122**, and the pressing roller **140** may include a pair of pressing rods. Each pressing rod of the pair of pressing rods may be rotatably connected to a corresponding pair of the two pairs of installation plates **122**. For example, each pressing rod of the pair of pressing rods may extend in a first direction, and the pair of pressing rods may be spaced apart from each other in a second direction perpendicular to the first direction. Each pair of two pairs of installation plates may be spaced apart from each other in the first direction, and the two pairs of the installation plates **122** may be spaced apart from each other in the second direction.
- (15) The wafer support unit **130** may be disposed in a space between the roller installation table **120**, and may include a support roller **132** for supporting the wafer **W**. As an example, a plurality of support rollers **132** may be disposed to support a lower end of the wafer **W**. In addition, the support roller **132** is connected to the rotation driving unit **112** so that the wafer **W** is rotated by the rotating support rollers **132**. In some embodiments, the support rollers **132** may rotatably support the lower end of the wafer **W**. In the present example embodiment, a case in which three support rollers **132** are provided on one side of the wafer support unit **130** is illustrated in the drawings as an example, but the number of support rollers **132** is not limited thereto and may be variously changed. In some embodiments, the support rollers **132** and the pair of pressing rods may be configured to place the wafer vertically. For example, the wafer may be placed in a gap between the pair of pressing rods, and an edge of the lower end of the wafer may be supported by the three support rollers **132**.

(16) As described above, when the wafer W is cleaned by the support roller 132, the wafer W may be rotated clockwise or counterclockwise. In some embodiments, the three support rollers 132 may rotate in the same direction, and the wafer W may rotate in the opposite direction. For example, in the event that the three support rollers 132 rotate clockwise, the wafer may be rotated in a counterclockwise direction using a friction force between the edge of the lower end of the wafer W and each of the three support rollers 132. The rotating wafer W may rotate the pair of pressing rods. A friction force between opposite surfaces of the wafer W and the pair of pressing rods may rotate the pair of pressing rods.

(17) The pressing roller 140 is installed on the roller installation table 120 to be disposed above the wafer support unit 130 to press opposite surfaces of the wafer W. As an example, a pair of the pressing rollers 140 (i.e., the pair of pressing rods) may be installed on the roller installation table 120 to press opposite surfaces of the wafer W. Meanwhile, the pressing roller 140 may be deformed so that the pressure for pressing a central portion and an edge of the wafer W is different from each other when the wafer W is pressed. To this end, the pressing roller 140 may be connected to the driving unit 150. Accordingly, as illustrated in FIG. 2, the pressing roller 140 may have a convex or concave central portion. For example, when force is applied outwardly to a central axis 142 of the pressing roller 140 by the driving unit 150, the pressing roller 140 may be deformed so that the central portion of the pressing roller 140 has a convex shape, as illustrated in FIG. 2(a), and when force is applied inwardly to the central axis 142 of the pressing roller 140 by the driving unit 150, the pressing roller 140 may be deformed so that the central portion of the pressing roller 140 has a concave shape, as illustrated in FIG. 2(b). In this case, as illustrated in FIG. 3, the pressing force may be adjusted as compared with the pressing roller in the prior art. It can be seen that FIG. 3(a) illustrates a high pressing force at the central portion of the wafer W and a low pressing force at the edge of the wafer W, but FIG. 3(b) illustrates a low pressing force at the central portion of the wafer W and a high pressing force at the edge of the wafer W. In some embodiments, the pair of pressing rods may be elastically deformed by the pressing force so that once the pressing force is released, the deformed pressing rods may return to their original shapes.

(18) As described above, the cleaning force of the wafer W may be adjusted by adjusting a magnitude and direction of the force applied to the central axis 142 of the pressing roller 140.

(19) The driving unit 150 causes a shape of the pressing roller 140 to be deformed. To this end, the driving unit 150 is connected to the pressing roller 140, and as an example, the driving unit 150 may include a plurality of air cylinders connected to a central axis 142 of the pressing roller 140. In other words, the driving unit 150 may be formed of an air cylinder connected to opposite ends of the central axis 142 of the pressing roller 140. For example, the driving unit 150 may further include a driving rod 150-1 that is connected to end portions of the pressing roller 140 so that a force may be applied to the end portions of the pressing roller 140 in a direction perpendicular to the central axis 142 of the pressing roller 140. In some embodiments, the central axis 142 may extend in a direction parallel to a direction along which the pressing roller 140 extends.

Accordingly, the central portion of the pressing roller 140 may be deformed to be concave or convex by applying force in a direction crossing the direction of the central axis 142 of the pressing roller 140. Accordingly, a magnitude of the force applied for deformation of the pressing roller 140 may be reduced, and the deformation of the pressing roller 140 may be performed more easily. In other words, compared to the case in which the pressing roller 140 is deformed by applying force in the direction of the central axis 142 of the pressing roller 140, the shape deformation of the pressing roller 140 may be implemented with less force, and control of the shape deformation may also be performed more easily. Here, a case in which the driving unit 150 is formed of an air cylinder is described as an example, but the present inventive concept is not limited thereto, and the driving unit 150 may be formed of a sub-motor, or the like.

(20) As described above, by deforming the shape of the pressing roller 140 by the driving unit 150, to press the wafer W, the cleaning force may be efficiently and precisely controlled.

(21) In an embodiment, the wafer cleaning apparatus may further include a pair of first extensions **143** and a pair of first connectors **144**. The pair of first connectors **144** may connect opposite ends of the pressing roller **140** to the pair of first extensions **143**. The pair of first connectors **144** may be rotatably connected to the opposite ends of the pressing roller **140**. The pair of first connectors **144** may be fixedly connected to the pair of first extensions **143**. The pair of first extensions **143** may penetrate the pair of installation plates **122** to be connected to the pair of first connectors **144**.

(22) FIG. 4 is an illustrative view illustrating a pressing roller and a backup roller provided in the apparatus for cleaning a wafer according to an example embodiment.

(23) The backup roller **260** serves to support the pressing roller **240** from an outside of the pressing roller **240**. Meanwhile, the driving unit **150** (see FIG. 1) is connected to the backup roller **260** to deform the backup roller **260**. To this end, the driving unit **150** may be connected to an axis **262** of the backup roller **260**. For example, the driving unit **150** may be formed of an air cylinder connected to opposite ends of the axis **262** provided in the backup roller **260**. As described above, while the backup roller **260** is deformed by the driving unit **150**, force may be applied to the pressing roller **240** so that the central portion of the pressing roller **240** may be deformed into a convex or concave shape. In some embodiments, the driving unit **150** may elastically deform the backup roller **260** to control deformation of the pressing roller **240**.

(24) As described above, by deforming the shape of the pressing roller **240** by the deformation of the backup roller **260**, the pressing force applied to the wafer W may be adjusted. Accordingly, the cleaning force of the wafer W may be efficiently and precisely controlled.

(25) Meanwhile, by supporting the pressing roller **240** by the backup roller **260**, it is possible to reduce vibrations and vibrations generated when the wafer W is cleaned. Furthermore, by deforming the backup roller **260** to deform the pressing roller **240**, permanent deformation (i.e., plastic deformation) of the pressing roller **240** may be avoided. In other words, since force may not be applied directly to the pressing roller **240**, permanent deformation of the central axis **242** of the pressing roller **240** may be suppressed.

(26) The backup roller **260** may be disposed side by side with the pressing roller **240** and may have a size (e.g., length) corresponding to the size (e.g., length) of the pressing roller.

(27) FIGS. 5 and 6 are illustrative views illustrating a pressing roller and a backup roller provided in an apparatus for cleaning a wafer according to an example embodiment.

(28) First, referring to FIG. 5, a backup roller **360** may be disposed to protrude toward one end of a pressing roller **340**. For example, as illustrated in FIG. 5, the backup roller **360** may be disposed to protrude to a left side of the pressing roller **340** to be disposed so that a central portion of the backup roller **360** supports one end of the pressing roller **340**. Accordingly, pressing force by which the pressing roller **340** presses the edge of the wafer W may be greater than the central portion of the wafer W.

(29) In addition, as illustrated in FIG. 6, the backup roller **460** may be disposed to protrude toward the other end of the pressing roller **440**. For example, as illustrated in FIG. 6, the backup roller **460** is arranged to protrude to a right side of the pressing roller **440** to be disposed so that a central portion of the backup roller **460** supports the other end side of the pressing roller **440**. Accordingly, pressing force by which the pressing roller **440** presses the edge of the wafer W may be greater than the central portion of the wafer W.

(30) FIG. 7 is an explanatory diagram illustrating a pressing roller and a backup roller provided in an apparatus for cleaning a wafer according to an example embodiment.

(31) Referring to FIG. 7, a backup roller **560** may be disposed to support a central portion of a pressing roller **540**. Meanwhile, the backup roller **560** may have a size, smaller than a size (e.g., length) of the pressing roller **540**, and accordingly, the backup roller **560** may be disposed to support only the central portion of the pressing roller **540**.

(32) Accordingly, pressing force applied to the wafer W by the pressing roller **540** may be greater than the pressing force at an edge of the wafer W at a central portion of the wafer W, as illustrated

in FIG. 9.

(33) FIG. 8 is an explanatory diagram illustrating a pressing roller and a backup roller provided in an apparatus for cleaning a wafer according to an example embodiment.

(34) Referring to FIG. 8, a backup roller 660 may be disposed to support opposite end portions of the pressing roller 640. For example, the backup rollers 660 may be respectively disposed one on opposite end portions of the pressing rollers 640, so that the four backup rollers 660 may support the pressing roller 640. Meanwhile, the backup roller 660 may have a size, smaller than a size (e.g., length) of the pressing roller 640, and accordingly, the backup roller 660 may be disposed to support only opposite end side portions of the pressing roller 640.

(35) Accordingly, pressing force applied to the wafer W by the pressing roller 640 may be smaller than pressing force at an edge of the wafer W in a central portion of the wafer W, as illustrated in FIG. 9.

(36) FIG. 10 is an explanatory diagram illustrating a pressing roller provided in an apparatus for cleaning a wafer according to an example embodiment.

(37) A pressing roller 740 may include a plurality of space portions S1 to S4 so that the pressing force applied to the wafer W (see FIG. 1) by pneumatic pressure varies. As an example, an amount of air filled in the plurality of space portions S1 to S4 may be different from each other.

Accordingly, the pressing force for pressing the wafer in a region disposed above the plurality of space portions may be different from each other. Meanwhile, in the present example embodiment, a case in which four or more space portions are provided is described as an example, but the number of space portions may be variously changed.

(38) As set forth above, according to the present inventive concept, an apparatus for cleaning a wafer capable of efficiently and precisely controlling cleaning power may be provided.

(39) Herein, a lower side, a lower portion, a lower surface, and the like, are used to refer to a direction toward a mounting surface of the fan-out semiconductor package in relation to cross sections of the drawings, while an upper side, an upper portion, an upper surface, and the like, are used to refer to an opposite direction to the direction. However, these directions are defined for convenience of explanation, and the claims are not particularly limited by the directions defined as described above.

(40) The meaning of a “connection” of a component to another component in the description includes an indirect connection through an adhesive layer as well as a direct connection between two components. In addition, “electrically connected” conceptually includes a physical connection and a physical disconnection. It can be understood that when an element is referred to with terms such as “first” and “second”, the element is not limited thereby. They may be used only for a purpose of distinguishing the element from the other elements, and may not limit the sequence or importance of the elements. In some cases, a first element may be referred to as a second element without departing from the scope of the claims set forth herein. Similarly, a second element may also be referred to as a first element.

(41) The term “an example embodiment” used herein does not refer to the same example embodiment, and is provided to emphasize a particular feature or characteristic different from that of another example embodiment. However, example embodiments provided herein are considered to be able to be implemented by being combined in whole or in part one with one another. For example, one element described in a particular example embodiment, even if it is not described in another example embodiment, may be understood as a description related to another example embodiment, unless an opposite or contradictory description is provided therein.

(42) Terms used herein are used only in order to describe an example embodiment rather than limiting the present disclosure. In this case, singular forms include plural forms unless interpreted otherwise in context.

(43) While example embodiments have been shown and described above, it will be apparent to

those skilled in the art that modifications and variations could be made without departing from the scope of the present inventive concept as defined by the appended claims.

## Claims

1. A wafer cleaning apparatus, comprising: a base; a roller installation table installed on the base; a wafer support unit disposed at the roller installation table and having a support roller for rotatably supporting an edge of a wafer; a pressing roller installed on the roller installation table and above the wafer support unit, and configured to press opposite surfaces of the wafer, wherein the pressing roller includes a pair of pressing rods, and wherein each of the pair of pressing rods extends in a first direction, and the pair of pressing rods are spaced apart from each other in a second direction perpendicular to the first direction so that the wafer supported by the wafer support unit is accommodated into a gap between the pair of pressing rods; and a driving unit providing a force in a direction, crossing a direction of a central axis of the pressing roller to bend the pair of pressing rollers inwardly or outwardly, wherein a shape of each pressing rod of the pair of pressing rods is deformable in response to the force by the driving unit, and wherein the pair of pressing rods bent by the driving unit applies a first pressure to a central portion of the wafer and a second pressure, different from the first pressure, to an edge portion of the wafer.
2. The wafer cleaning apparatus of claim 1, wherein the driving unit is connected to opposite end portions of each of the pair of pressing rods, and wherein the driving unit is configured to apply the force in the direction perpendicular to the central axis of the pressing roller so that a central portion of each of the pair of pressing rods is convex away or concave toward the central portion of the wafer.
3. The wafer cleaning apparatus of claim 1, further comprising: a backup roller layered on the outside of the pressing roller.
4. The wafer cleaning apparatus of claim 3, wherein the driving unit is connected to the backup roller, and wherein the driving unit is configured to cause deformation of the backup roller to control the deformation of the pressing roller.
5. The wafer cleaning apparatus of claim 4, wherein the driving unit is connected to an end portion of the backup roller, and wherein the driving unit is configured to apply a force to the end portion of the backup roller in a direction perpendicular to a central axis of the backup roller to control the deformation of the pressing roller.
6. The wafer cleaning apparatus of claim 3, wherein each of the pressing roller and the backup roller extends in the first direction, wherein the backup roller and the pressing roller are disposed side by side in the second direction perpendicular to the first direction, and wherein the pressing roller and the backup roller are the same in length in the first direction.
7. The wafer cleaning apparatus of claim 3, wherein each of the pressing roller and the backup roller extends in the first direction, wherein the backup roller and the pressing roller are disposed side by side in the second direction perpendicular to the first direction, and wherein the backup roller protrudes from one end portion of the pressing roller in the first direction.
8. The wafer cleaning apparatus of claim 3, wherein each of the pressing roller and the backup roller extends in the first direction, wherein the backup roller and the pressing roller are disposed side by side in the second direction perpendicular to the first direction, and wherein the backup roller has a length, in the first direction, smaller than a length, in the first direction, of the pressing roller.
9. The wafer cleaning apparatus of claim 8, wherein the backup roller covers a central portion of the pressing roller and exposes an end portion of the pressing roller.
10. The wafer cleaning apparatus of claim 8, wherein the backup roller is provided in plural, and wherein the plurality of backup rollers are respectively disposed on opposite end portions of the pressing roller.



11. The wafer cleaning apparatus of claim 1, wherein the wafer support unit and the pressing roller are configured to place the wafer in a vertical direction, wherein the wafer support unit contacts an edge of a lower end portion of the wafer placed in the vertical direction, wherein the pressing roller contacts the opposite surfaces of the wafer, wherein the support roller of the wafer support unit is provided in plural, and wherein the plurality of support rollers are configured to rotatably support the edge of the lower end portion of the wafer.

12. A wafer cleaning apparatus, comprising: a base; a roller installation table installed on the base; a wafer support unit disposed between the roller installation table and having a support roller for rotatably supporting a wafer; and a pressing roller installed on the roller installation table and above the wafer support unit, and configured to press opposite surfaces of the wafer, wherein the pressing roller is provided with a plurality of space portions configured to apply a pneumatic pressure on the opposite surfaces of the wafer.

13. The wafer cleaning apparatus of claim 12, wherein an amount of air filled in the plurality of space portions is different from each other.

14. A wafer cleaning apparatus, comprising: a base; a pair of first installation plates immovably fixed at the base and erected vertically from the base during an operation of the wafer cleaning apparatus; a first pressing roller rotatably connected to the pair of first installation plates, wherein the first pressing roller extends in a first direction and the pair of first installation plates are spaced apart from each other in the first direction; a pair of second installation plates immovably fixed at the base and erected vertically from the base during the operation of the wafer cleaning apparatus, wherein the pair of second installation plates are spaced apart from the pair of first installation plates in a second direction perpendicular to the first direction; a second pressing roller rotatably connected to the pair of second installation plates, wherein the second pressing roller extends in the first direction and is spaced apart from the first pressing roller in the second direction; and a plurality of support rollers disposed between the base and a gap between the first pressing roller and the second pressing rollers, wherein the plurality of support rollers are controlled to rotate in a same direction.

15. The wafer cleaning apparatus of claim 14, further comprising: a pressing roller driver configured to apply a pressing force to opposite end portions of each of the first pressing roller and the second pressing rollers in a direction perpendicular to a central axis of each of the first pressing roller and the second pressing rollers.

16. The wafer cleaning apparatus of claim 15, further comprising: a pair of first extensions; and a pair of first connectors, wherein the pair of first connectors connect opposite ends of the first pressing roller to the pair of first extensions.

17. The wafer cleaning apparatus of claim 16, wherein the pair of first connectors are rotatably connected to the opposite ends of the first pressing roller.

18. The wafer cleaning apparatus of claim 17, wherein the pair of first connectors are fixedly connected to the pair of first extensions, and wherein the pair of first extensions penetrate the pair of first installation plates.

19. The wafer cleaning apparatus of claim 16, wherein the pressing roller driver includes a pair of rods connected to the pair of first extensions, wherein each of the pair of rods extends in the second direction, and wherein the pressing force is delivered to the first pressing roller via the pair of rods.

20. The wafer cleaning apparatus of claim 14, wherein each of the first pressing roller and the second pressing rollers is provided with a plurality of space portions configured to apply a pneumatic pressure on opposite surfaces of a wafer erected vertically in the gap between the first pressing roller and the second pressing rollers.

---