

WAFER POLISHING SYSTEM

Technical Field

- 5 **[0001]** The invention belongs to the technical field of semiconductor integrated circuit chip fabrication, and particularly relates to a wafer polishing system.

Description of Related Art

[0002] A chemical mechanical planarization (CMP) device is one of the seven key devices in the field of integrated circuit fabrication.

- 10 **[0003]** At present, the chemical mechanical polishing technique has evolved to integrate online measurement, online end-point detection, cleaning and other processes together, thanks to the development of integrated circuits towards miniaturization, multi-layer, thinness, and planarization, and is also a necessary process for increasing the diameter of wafers from 200 mm to 300 mm or above, increasing productivity, reducing fabrication costs, and realizing global
15 planarization of substrates.

- [0004]** A chemical mechanical polishing and planarization device typically comprises an EFEM (Equipment Front End Module), a cleaning unit and a polishing unit. The EFEM mainly comprises a wafer box for storing wafers, a wafer transfer manipulator and an air purification system; the cleaning unit mainly comprises different numbers of megasonic cleaning components, brush
20 cleaning components, drying components, and devices for transferring wafers between the components; the polishing unit typically comprises a workbench, a polishing disk, a polishing head, a polishing arm, a trimmer and a polishing solution arm, and all the components are arranged on the workbench according to their process positions. It is found from the actual wafer processing practices that the spatial arrangement of the polishing units, the cleaning and wafer transfer
25 modules, etc. has a great influence on the polishing output of the whole chemical mechanical polishing and planarization device; and wafers are generally transferred between the polishing

units and the outside as well as between the polishing units by means of a loading and unloading platform.

[0005] As for the spatial arrangement of the loading and unloading platform and the polishing units, a square arrangement of the loading and unloading platform and three polishing units has been adopted by most chemical mechanical polishing and planarization devices on the market as shown in FIG. 1. Four polishing heads are fixed on a cross-shaped rotary workbench, which means that each wafer entering the polishing area corresponds to one polishing head, one loading and unloading platform provides loading and unloading service for three polishing units, the number of the polishing heads and the number of polishing platforms cannot be adjusted, and the polishing time of each polishing head cannot be separately controlled, leading to poor timeliness and low flexibility; and liquids on different polishing platforms are easy to splash to result in a cross influence, compromising the polishing effect and leading to a complex process.

SUMMARY

[0006] To overcome the defects in the prior art, the invention provides a wafer polishing system in which each polishing module of the wafer polishing system can be controlled separately, so the control flexibility is high; all polishing modules share one wafer transfer passage, so the spatial arrangement of devices is compact; and the movement trajectory of wafers is designed to guarantee high wafer transfer efficiency, so the polishing efficiency is improved.

[0007] The technical solution adopted by the invention to settle the technical problems is as follows: a wafer polishing system comprises at least one polishing unit;

the polishing unit comprises a wafer transfer passage and at least two polishing modules located on two sides of the wafer transfer passage;

each of the polishing modules comprises a polishing platform and a polishing arm capable of driving a wafer to move with respect to the polishing platform to implement a polishing process;

at least two working positions are arranged in the wafer transfer passage, and a wafer transfer device is able to move between the working positions;

after the polishing arm of one polishing module obtains the wafer from one working position in the wafer transfer passage, the polishing process is completed, the wafer is placed back
5 into the wafer transfer passage along a first trajectory, and the wafer transfer device moves to transfer the wafer to the other working position, from which the polishing arm of the other polishing module obtains the wafer along a second trajectory to complete another polishing process;

the first trajectory, a movement trajectory of the wafer transfer device and the second
10 trajectory are approximately Z-shaped.

[0008] Further, a number of the working positions is the same as a number of the polishing arms.

[0009] Further, the polishing arms of the polishing modules are centrosymmetric with respect to a centre point of a connecting line between the working positions at initial and tail ends.

[0010] Further, the first trajectory is an arc line, a straight line or approximately a straight line;
15 and the second trajectory is an arc line, a straight line or approximately a straight line.

[0011] Further, the polishing arm drives the wafer to reciprocate with respect to the polishing platform along an arc trajectory to implement the polishing process, and the arc trajectory is concentric with the arc-shaped first trajectory or the arc-shaped second trajectory.

[0012] Further, a number of wafer transfer device is one.

20 **[0013]** Further, a number of the polishing modules is two, and the polishing arms of the two polishing modules are both close to the wafer transfer passage and are arranged diagonally with respect to the wafer transfer passage.

[0014] Further, after a first polishing arm obtains the wafer from a first working position, the wafer is polished on a first polishing platform; after the corresponding polishing module completes
25 the polishing process, the first polishing arm places the wafer back to the first working position, the wafer transfer device moves from the first working position to a second working position, a

second polishing arm obtains the wafer from the second working position, and the wafer is polished on a second polishing platform; and at the same time, another wafer is placed on the wafer transfer device, the wafer transfer device moves from the second working position to the first working position, and the first polishing arm obtains the wafer for polishing.

5 **[0015]** Further, the wafer transfer device transfers the wafer from the first working position to the second working position, and the first polishing arm is cleaned at the first working position and rotates to the first polishing platform for polishing after obtaining a new wafer.

[0016] Further, after a first polishing arm obtains the wafer from a first working position, the wafer is polished on a first polishing platform; after the corresponding polishing module completes
10 the polishing process, the first polishing arm places the wafer back to the first working position and rotates to the first polishing platform, the wafer transfer device moves from the first working position to a second working position, a second polishing arm obtains the wafer from the second working position, and the wafer is polished on a second polishing platform; and the wafer transfer device moves from the second working position to the first working position, and another wafer
15 is placed on the wafer transfer device to be obtained by the first polishing arm from the first working position.

[0017] Further, after the wafer transfer device moves away from the first working position, the first polishing arm is cleaned at the first working position and then rotates to the first polishing platform.

20 **[0018]** Further, after the first polishing arm obtains the wafer from the first working position, the wafer is polished on the first polishing platform; after the corresponding polishing module completes the polishing process, the first polishing arm places the wafer back to the first working position, the wafer transfer device moves from the first working position to the second working position, a second polishing arm obtains the wafer from the second working position, and the
25 wafer is polished on the second polishing platform; and the wafer transfer device moves from the second working position to the first working position, the first polishing arm rotates to the first

polishing platform, and another wafer is placed on the wafer transfer device to be obtained by the first polishing arm from the first working position.

[0019] Further, before another wafer is placed on the wafer transfer device, the first polishing arm is cleaned.

5 **[0020]** Further, a number of the polishing unit is two or more, and the two or more polishing units are sequentially arranged in an extension direction of the wafer transfer passage.

[0021] The invention has the following beneficial effects: (1) the polishing arm of each polishing module is controlled separately, so a better stability and a higher flexibility are achieved; (2) the working time of each polishing module can be controlled separately to satisfy different
10 polishing requirements; (3) the cross influence of polishing liquids of different polishing modules is avoided, so the polishing effect is better; (4) the trajectories in the whole working process are simple and smooth, and the movement distance in the whole polishing process is short, so the polishing efficiency is high; and (5) with multiple polishing units being sequentially arranged along the wafer transfer passage, so that any number of polishing units or polishing modules can
15 be selected as required to implement the whole polishing process, to adapt to different process requirements.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] FIG. 1 is a simplified schematic diagram of a wafer polishing system in the prior art.

20 **[0023]** FIG. 2 is a schematic diagram of a polishing unit according to Embodiment 1 of the invention.

[0024] FIG. 3 is a schematic diagram of the polishing unit with a movement trajectory (a first trajectory is an arc line) according to Embodiment 1 of the invention.

[0025] FIG. 4 is a schematic diagram of the polishing unit with a movement trajectory (the first
25 trajectory is a straight line) according to Embodiment 1 of the invention.

[0026] FIG. 5 is a schematic diagram of the arrangement of multiple polishing units according

to Embodiment 1 of the invention.

[0027] FIG. 6 is a movement diagram according to Embodiment 1 of the invention.

[0028] FIG. 7 is a movement diagram according to Embodiment 2 of the invention.

[0029] FIG. 8 is a movement diagram according to Embodiment 3 of the invention.

5 **[0030]** Wherein: 1, polishing unit; 2, wafer transfer passage; 3, polishing module; 311, first polishing platform; 312, second polishing platform; 321, first polishing arm; 322, second polishing arm; 41, first working position; 42, second working position; 51, first trajectory; 52, movement trajectory of wafer transfer device; 53, second trajectory.

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DESCRIPTION OF THE EMBODIMENTS

[0031] To allow those skilled in the art to have a better understanding of the solutions of the invention, the technical solutions in the embodiments of the invention will be clearly and completely described below in conjunction with accompanying drawings in the embodiments of the invention. Obviously, the embodiments in the following description are merely illustrative
15 ones, and are not all possible ones of the invention. All other embodiments obtained by those ordinarily skilled in the art according to the following ones without creative labor should also fall within the protection scope of the invention.

[0032] [Embodiment 1]

[0033] A wafer polishing system comprises at least one polishing unit 1.

20 **[0034]** As shown in FIG. 2, the polishing unit 1 comprises a wafer transfer passage 2 and at least two polishing modules 3 located on two sides of the wafer transfer passage 2.

[0035] Each polishing module 3 comprises a polishing platform and a polishing arm capable of driving a wafer to move with respect to the polishing platform to implement a polishing process; here, “move” means that the wafer moves synchronously with the polishing arm or the wafer and
25 the polishing arm move relatively.

[0036] At least two working positions are arranged in the wafer transfer passage 2, and a wafer

transfer device is able to move between the working positions.

[0037] In this embodiment, the number of the working positions is the same as the number of the polishing arms. The polishing arms of the polishing modules 3 are centrosymmetric with respect to a centre point of a connecting line between the working positions at initial and tail ends.

5 **[0038]** After the polishing arm of one polishing module 3 obtains a wafer from one working position in the wafer transfer passage 2 along a first trajectory 51, the wafer is polished on the polishing platform of the polishing module 3; next, the polished wafer is placed back into the wafer transfer passage 2 along the first trajectory 51, and the wafer transfer device moves to transfer the wafer in the wafer transfer passage 2 to the other working position; and the polishing
10 arm of the other polishing module 3 obtains the wafer from the working position in the wafer transfer passage 2 along a second trajectory 52, and then the wafer is polished on the polishing platform of the other polishing module 3.

[0039] As shown in FIG. 3, the first trajectory 51, a movement trajectory 52 of the wafer transfer device and the second trajectory 53 are approximately Z-shaped. Here, “approximately” means
15 that the first trajectory 51, the movement trajectory 52 of the wafer transfer device and the second trajectory 53 are not necessarily straight lines and may be curved and arc lines with small waves, but the overall movement trend is a straight line on the whole when seen on the macro level.

[0040] In this embodiment, one wafer transfer device is arranged, each polishing unit 1 comprises two polishing modules 3, and the polishing arms of the two polishing modules 3 are
20 both close to the wafer transfer passage 2 and are arranged diagonally with respect to the wafer transfer passage 2, as shown in FIG. 2. That is, the working positions comprises a first working position 41 and a second working position 42, the polishing arms comprise a first polishing arm 321 and a second polishing arm 322, and the polishing platforms comprise a first polishing platform 311 and a second polishing platform 312.

25 **[0041]** The first trajectory 51 is an arc line, and the second trajectory 53 is also an arc line, as shown in FIG. 3. In this case, a wafer is driven by the first polishing arm 321 to reciprocate with

respect to the first polishing platform 311 along an arc trajectory to be polished, the arc trajectory and the first trajectory 51 are concentric or are even located on the same circumference; or, the first polishing arm 321 and the wafer move relatively to form an arc trajectory and then stop moving relatively, and the wafer is then driven by the first polishing arm 321 to be transferred
5 along the first trajectory 51; the wafer is driven by the second polishing arm 322 to reciprocate with respect to the second polishing platform 312 along an arc trajectory to be polished, and the arc trajectory and the second trajectory 53 are concentric or are even located on the same circumference; or, the second polishing arm 322 and the wafer move relatively to form an arc trajectory and then stop moving relatively, and the wafer is then driven by the second polishing
10 arm 322 to be transferred along the second trajectory 53.

[0042] Alternatively, as shown in FIG. 4, the first trajectory 51 is a straight line or rather is approximately a straight line, and in this case, when the first polishing arm 321 drives a wafer to move, the wafer and the first polishing arm 321 move relatively to form the straight first trajectory 51; the second trajectory 53 is a straight line or rather is approximately a straight line, and in this
15 case, when the second polishing arm 322 drives the wafer to move, the wafer and the second polishing arm 322 move relatively to form the straight second trajectory 53. In the case where the first trajectory 51 and the second trajectory 53 are straight lines, the relative movement distance of the wafer is minimized, thus improving polishing efficiency.

[0043] In addition, when the first polishing arm 321 drives the wafer to move, the wafer and the
20 first polishing arm 321 move relatively, and the relative movement distance can be set as required to make the first trajectory 51 to be an irregular line. Similarly, the second trajectory 53 may also be an irregular line.

[0044] As shown in FIG. 5, the number of the polishing units 1 may be two or more, and the polishing units are sequentially arranged in an extension direction of the wafer transfer passage 2.

[0045] As shown in FIG. 6, based on the above system arrangement, the working process of the
25 wafer polishing system may be as follows: after the first polishing arm 321 obtains a wafer from

the first working position 41, the wafer is polished on the first polishing platform 311; after the polishing module 3 completes the polishing process, the first polishing arm 321 places the wafer back to the first working position 41, and the wafer transfer device (not shown) moves from the first working position 41 to the second working position 42, and the first polishing arm 321 may stay at the first working position 41 or may be cleaned at the first working position 41; after the second polishing arm 322 obtains the wafer from the second working position 42, the wafer is polished on the second polishing platform 312; at the same time, another wafer is placed on the wafer transfer device by means of a manipulator, and the wafer transfer device moves from the second working position 42 to the first working position 41, and the first polishing arm 321 obtains a wafer from the first working position 41 for polishing.

[0046] By setting the above working process, (1) wafers can be transferred between the first working position 41 and the second working position 42 to be continuously carried on site without rotating back the first polishing arm 321, and every time the first polishing arm 321 rotates to the wafer transfer passage 2, one wafer is discharged from the polishing platform and one wafer is fed to the polishing platform; (2) the wafer transfer device can move flexibly between the first working position 41 and the second working position 42 and can be used to the maximum extent to complete wafer discharging and feeding at each working position; (3) the first polishing arm 321, the second polishing arm 322 and the wafer transfer device will not run idly, and through such an ingenious design, the space, time and components are all used to the maximum extent.

[0047] [Embodiment 2]

[0048] As shown in FIG. 7, this embodiment is identical with Embodiment 1 in arrangement and differs from Embodiment 1 in the working process of the wafer polishing system. The working process of the wafer polishing system in this embodiment is as follows: after the first polishing arm 321 obtains a wafer from the first working position 41, the wafer is polished on the first polishing platform 311; after the polishing module 3 completes the polishing process, the first polishing arm 321 places the wafer back to the first working position 41 and then rotates back to

the first polishing platform 311, and the wafer transfer device moves from the first working position 41 to the second working position 42; after the second polishing arm 322 obtains the wafer from the second working position 42, the wafer is polished on the second polishing platform 312; the empty wafer transfer device moves from the second working position 42 to the first working position 41, another wafer is placed on the wafer transfer device, and the first polishing arm 321 rotates from the first polishing platform 311 to the first working position 41 to obtain the wafer for polishing.

[0049] After the wafer transfer device moves away from the first working position 41, the first polishing arm 321 rotates from the first polishing platform 311 to the first working position 41 to be cleaned and then rotates back to the first polishing platform 311 to wait for the next rotation to the first working position 41. Alternatively, after the wafer transfer device moves away from the first working position 41, the first polishing arm 321 stays at the first polishing platform 311 and rotates from the first polishing platform 311 to the first working position 41 to be cleaned before the empty wafer transfer device moves from the second working position 42 to the first working position 41; and after the first polishing arm 321 is cleaned, the wafer transfer device moves to the first working position 41, and the first polishing arm 321 directly obtains a wafer for polishing.

[0050] By setting the above working process, the first polishing arm 321 returns to the first polishing platform 311 and then rotates to the first working position 41 to obtain a wafer to give way to other components, such that there will be more possibilities for the process of placing a wafer on the first working position 41, and spatial hindrances caused by the stay of the first polishing arm 321 are avoided.

[0051] [Embodiment 3]

[0052] As shown in FIG. 8, this embodiment is identical with Embodiment 1 in arrangement and differs from Embodiment 1 in the working process of the wafer polishing system. The working process of the wafer polishing system in this embodiment is as follows: after the first polishing arm 321 obtains a wafer from the first working position 41, the wafer is polished on the first

polishing platform 311; and after the polishing module 3 completes the polishing process, the first polishing arm 321 places the wafer back to the first working position 41, and the wafer transfer device moves from the first working position 41 to the second working position 42; after the second polishing arm 322 obtains the wafer from the second working position 42, the wafer is polished on the second polishing platform 312; the empty wafer transfer device moves from the second working position 42 to the first working position 41, the first polishing arm 321 rotates back to the first polishing platform 311, another wafer is placed on the wafer transfer device, and the first polishing arm 321 rotates from the first polishing platform 311 to the first working position 41 to obtain a wafer for polishing.

[0053] Before another wafer is placed on the wafer transfer device, the first polishing arm 321 is cleaned, which may be implemented within the time the wafer transfer device moves from the first working position 41 to the second working position 42, the time the wafer is polished on the second polishing platform 312, or the time the wafer transfer device moves from the second working position 42 to the first working position 41.

[0054] By setting the above working process, the first polishing arm 321 returns to the first polishing platform 311 and then rotates to the first working position 41 to obtain a wafer to give way to other components, such that there will be more possibilities for the process of placing a wafer on the first working position 41, spatial hindrances caused by the stay of the first polishing arm 321 are avoided, and the adaptability is better.

[0055] The above specific embodiments are merely used for explaining the invention, and are not intended to limit the invention. Any modifications and variations made to the invention within the spirit of the invention and the protection scope of the claims should also fall within the protection scope of the invention.

WHAT IS CLAIMED IS:

1. A wafer polishing system, characterized in that, comprising:

at least one polishing unit;

wherein, the polishing unit comprises a wafer transfer passage and at least two

5 polishing modules located on two sides of the wafer transfer passage;

each of the polishing modules comprises a polishing platform and a polishing arm capable of driving a wafer to move with respect to the polishing platform to implement a polishing process;

at least two working positions are arranged in the wafer transfer passage, and a wafer
10 transfer device is able to move between the working positions;

after the polishing arm of one polishing module obtains the wafer from one working position in the wafer transfer passage, the polishing process is completed, the wafer is placed back into the wafer transfer passage along a first trajectory, and the wafer transfer device moves to transfer the wafer to the other working position, from which the polishing arm of the other
15 polishing module obtains the wafer along a second trajectory to complete another polishing process;

the first trajectory, a movement trajectory of the wafer transfer device and the second trajectory are approximately Z-shaped.

2. The wafer polishing system according to claim 1, characterized in that, a number
20 of the working positions is the same as a number of the polishing arms.

3. The wafer polishing system according to claim 2, characterized in that, the polishing arms of the polishing modules are centrosymmetric with respect to a centre point of a connecting line between the working positions at initial and tail ends.

4. The wafer polishing system according to claim 1, characterized in that, the first
25 trajectory is an arc line, a straight line or approximately a straight line; and the second trajectory is an arc line, a straight line or approximately a straight line.

5. The wafer polishing system according to claim 4, characterized in that, the polishing arm drives the wafer to reciprocate with respect to the polishing platform along an arc trajectory to implement the polishing process, and the arc trajectory is concentric with the arc-shaped first trajectory or the arc-shaped second trajectory.

5 6. The wafer polishing system according to claim 1, characterized in that, a number of the wafer transfer device is one.

7. The wafer polishing system according to claim 2, characterized in that, a number of the polishing modules is two, and the polishing arms of the two polishing modules are both close to the wafer transfer passage and are arranged diagonally with respect to the wafer transfer
10 passage.

8. The wafer polishing system according to claim 7, characterized in that, after a first polishing arm obtains the wafer from a first working position, the wafer is polished on a first polishing platform; after the corresponding polishing module completes the polishing process, the first polishing arm places the wafer back to the first working position, the wafer transfer device
15 moves from the first working position to a second working position, a second polishing arm obtains the wafer from the second working position, and the wafer is polished on a second polishing platform; and at the same time, another wafer is placed on the wafer transfer device, the wafer transfer device moves from the second working position to the first working position, and the first polishing arm obtains the wafer for polishing.

20 9. The wafer polishing system according to claim 8, characterized in that, the wafer transfer device transfers the wafer from the first working position to the second working position, and the first polishing arm is cleaned at the first working position and rotates to the first polishing platform for polishing after obtaining a new wafer.

10. The wafer polishing system according to claim 7, characterized in that, after a first
25 polishing arm obtains the wafer from a first working position, the wafer is polished on a first polishing platform; after the corresponding polishing module completes the polishing process, the

first polishing arm places the wafer back to the first working position and rotates to the first polishing platform, the wafer transfer device moves from the first working position to a second working position, a second polishing arm obtains the wafer from the second working position, and the wafer is polished on a second polishing platform; and the wafer transfer device moves from the second working position to the first working position, and another wafer is placed on the wafer transfer device to be obtained by the first polishing arm from the first working position.

11. The wafer polishing system according to claim 10, characterized in that, after the wafer transfer device moves away from the first working position, the first polishing arm is cleaned at the first working position and then rotates to the first polishing platform.

12. The wafer polishing system according to claim 7, characterized in that, after a first polishing arm obtains the wafer from the first working position, the wafer is polished on a first polishing platform; after the corresponding polishing module completes the polishing process, the first polishing arm places the wafer back to the first working position, the wafer transfer device moves from the first working position to a second working position, a second polishing arm obtains the wafer from the second working position, and the wafer is polished on a second polishing platform; and the wafer transfer device moves from the second working position to the first working position, the first polishing arm rotates to the first polishing platform, and another wafer is placed on the wafer transfer device to be obtained by the first polishing arm from the first working position.

13. The wafer polishing system according to claim 12, characterized in that, before another wafer is placed on the wafer transfer device, the first polishing arm is cleaned.

14. The wafer polishing system according to claim 1, characterized in that, a number of the polishing unit is two or more, and the two or more polishing units are sequentially arranged in an extension direction of the wafer transfer passage.