

VACUUM PUMPING SYSTEM AND METHOD

FIELD OF THE INVENTION

The field of the invention relates to vacuum pumping systems, in particular those
5 used for evacuating systems for transferring wafers to and from processing
chambers.

BACKGROUND

Wafer handling or transfer systems provide a way of introducing and removing
10 wafers from semiconductor processing chambers without unduly affecting the
vacuum within the processing chamber or introducing contaminants into the
system. These transfer systems generally comprise smaller load lock chambers
configured to cycle between atmosphere and a low pressure. These chambers
are used to transfer wafers from atmospheric pressure into a wafer transfer
15 chamber that is held at a low pressure at or close to the pressure within the
semiconductor processing chambers. It may be desirable to increase the
number of wafers that the wafer transfer system can handle within a given time,
and a limiting factor to this may be the speed with which the load lock chambers
can be evacuated to the required pressure. This could be addressed by
20 increasing the size and capacity of a vacuum pump used to evacuate these
chambers, however such a solution has a cost overhead.

SUMMARY

A first aspect provides a vacuum pumping system for evacuating a vacuum
25 system, said vacuum system comprising a plurality of vacuum chambers
comprising at least one smaller vacuum chamber operable to cycle between a
predetermined pressure that is below atmospheric pressure and atmospheric
pressure, and a larger vacuum chamber; said vacuum pumping system
comprising: a first vacuum pump; a second vacuum pump; a valve system
30 configured to selectively connect and isolate said first and second vacuum pumps
with said plurality of vacuum chambers; and control circuitry configured: in
response to determining that a pressure within one of said at least one smaller

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vacuum chambers is to fall to said predetermined pressure within a first time period, to control said valve system such that said first and second pump are isolated from said larger vacuum chamber and are in fluid communication with said smaller vacuum chamber, such that both said first and second pumps
5 contribute to evacuating said smaller vacuum chamber to said predetermined pressure; and when said smaller vacuum chamber is at said predetermined pressure, to control said valve system such that said second vacuum pump is isolated from said smaller vacuum chamber and said second vacuum pump is in fluid communication with said larger vacuum chamber such that said second
10 vacuum pump pumps said larger vacuum chamber.

Vacuum systems such as wafer transfer stations that have a larger vacuum chamber configured to maintain a substantially constant low pressure and smaller vacuum chambers that cycle between atmosphere and a lower pressure have
15 differing pumping load requirements at different times. It was recognised that for a pumping system with multiple vacuum pumps, the differing load requirements might be efficiently met by providing some sharing of the vacuum pumps and that such sharing of the vacuum pumps may enable the system to provide an increased pumping speed to the smaller vacuum chambers when needed, while
20 still being able to retain a substantially constant lower pressure within the larger vacuum chamber. In effect the pump used to maintain the vacuum in the larger vacuum chamber may be periodically switched to assist in the evacuation of the smaller vacuum chamber(s), thereby providing increased pumping capacity when required, while still being able to maintain the required vacuum in the larger
25 vacuum chamber.

The pumping system comprises a first and second vacuum pump, valves and control circuitry, the control circuitry controlling the valves such that the two pumps are both coupled to the smaller vacuum chamber during at least a portion
30 of the period when it is being evacuated from atmosphere to the lower pressure, the second vacuum pump being coupled to the larger vacuum chamber when the smaller vacuum chamber has reached the lower pressure. In effect the second

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vacuum pump that is generally used to maintain the larger vacuum chamber at its lower pressure is used to help provide increased pumping capacity for the time, or at least a portion of the time, that the smaller vacuum chamber is to be evacuated. This increases the speed of the evacuation of the smaller vacuum chamber and has a limited effect on the larger vacuum chamber. In this way increased pumping capacity is provided without the need to provide an additional or an enlarged pump.

The smaller vacuum chamber is a vacuum chamber that is smaller than the larger vacuum chamber. It may be slightly smaller or it may be over ten times smaller. For example the larger chamber vacuum chamber may be about 300 litres and the smaller vacuum chamber may be about 20 litres.

In some embodiments, said control circuitry is configured to control said valve system to isolate said second vacuum pump from said smaller vacuum chamber and to connect said second vacuum pump with said larger vacuum chamber in response to determining that said smaller vacuum chamber has reached said predetermined pressure.

Although the additional pumping capacity may be provided for only a portion of the time period that the smaller vacuum chamber is being evacuated in some embodiments it is provided for the whole time period, the second vacuum pump being coupled to the smaller vacuum chamber in response to detecting the start of the evacuation process and uncoupled from it in response to detecting the desired pressure being reached.

In some embodiments, said vacuum system is such that when said smaller vacuum chamber is to return to atmospheric pressure said first vacuum pump is isolated from said smaller vacuum chamber.

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The control circuitry in the vacuum system may control valves between the chambers and the pumps to couple the pumps to the required chambers during

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an evacuation cycle. These valves may be part of the vacuum system and may be close to and associated with the chambers. The control circuitry of the pumping system may control a valve system of the pumping system to enable the second vacuum pump to assist the first vacuum pump in evacuating the smaller vacuum chamber and to isolate the second vacuum pump from the larger vacuum chamber during this period.

In some embodiments, said vacuum system is configured to periodically couple said larger vacuum chamber with said at least one smaller vacuum chamber when said at least one smaller vacuum chamber is at said predetermined pressure.

In some embodiments, said vacuum system further comprises a second smaller vacuum chamber operable to cycle between a second predetermined pressure and atmospheric pressure within a second time period, said second time period not overlapping in time with said first time period, said vacuum system comprising valves such that said first vacuum pump is in fluid communication with said smaller vacuum chamber during said cycle where said smaller vacuum chamber is being evacuated to a first predetermined pressure and to said second smaller vacuum chamber during said cycle where said second smaller vacuum chamber is being evacuated to said second predetermined pressure.

The system being evacuated may comprise a single smaller vacuum chamber or there may be multiple smaller chambers. These chambers may cycle between the same or different predetermined pressures in the same or different time periods, the time periods during which the chambers are evacuated may not overlap with each other, allowing a single pump to evacuate each of them at different times.

In some embodiments, said vacuum system is configured to control valves within the vacuum system such that said first vacuum pump is isolated from said second smaller vacuum chamber during a period where said smaller vacuum

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chamber is being evacuated to said first predetermined pressure and is isolated from said smaller vacuum chamber during a period where said second smaller vacuum chamber is being evacuated to said second predetermined pressure.

- 5 Where the cyclic evacuation of the smaller vacuum chambers do not overlap in time then the first vacuum pump may be used to evacuate each of the chambers at different times. This may be controlled by valves in the vacuum system.

10 In some embodiments, where a duration of said first and second time period are substantially the same, said control system is configured: in response to determining that a pressure within said second smaller vacuum chamber is to fall to said second predetermined pressure within said second time period, to control said valve system such that said first and second pump are isolated from said larger vacuum chamber and are in fluid communication with said second smaller
15 vacuum chamber, such that both said first and second vacuum pumps contribute to evacuating said second smaller vacuum chamber to said second predetermined pressure; and to control said valve system such that said second vacuum pump is isolated from said second smaller vacuum chamber and said second vacuum pump is in fluid communication with said larger vacuum chamber
20 such that said second vacuum pump pumps said larger vacuum chamber when said second smaller vacuum chamber is at said second predetermined pressure.

Where the two smaller chambers have the same evacuation time restraints then it may be that both use the two vacuum pumps to contribute to the evacuation
25 during at least a portion of the evacuation cycle and the valves may be controlled to achieve this.

In some embodiments, a duration of said second time period is more than 35% longer than a duration of said first time period and said control system is
30 configured: in response to determining that a pressure within said second smaller vacuum chamber is to fall to control said valve system such that said first vacuum pump is in fluid communication with said second smaller vacuum

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chamber and said second vacuum pump is isolated from said second smaller vacuum chamber and is in fluid communication with said larger vacuum chamber.

Where the second smaller vacuum chamber may be evacuated more slowly than
5 the first smaller vacuum chamber then it may be that it does not require additional pumping capacity and the second vacuum pump may remain coupled to the larger vacuum chamber while the second smaller vacuum chamber is evacuated.

In some embodiments, said first and second predetermined pressure comprise
10 substantially a same pressure, while in other embodiments they may be slightly different pressures.

The predetermined pressures that the smaller one or more vacuum chambers are evacuated to and the pressure that the larger vacuum chamber is maintained at
15 may be within 30% of each other. Similar pressures in the chambers mean that when the smaller and larger chambers are coupled together to move wafers for example between them, then there is not an undue pressure difference and only a limited amount of gas passes between the chambers. Limiting the gas flow helps stop particulates being stirred up and moving between the chambers. In
20 some embodiments, it may be advantageous if the smaller vacuum chamber is at a lower pressure than the larger vacuum chamber when they are coupled together such that any particulates that are disturbed are sucked into the smaller vacuum chamber away from the larger vacuum chamber that may be configured for coupling to a process chamber. However, in other embodiments the larger
25 vacuum chamber may be maintained at a lower pressure than the pressure that the smaller vacuum chamber(s) is pumped to. Periodically attaining the reduced pressure in the smaller vacuum chambers is, in some cases, the time critical step and thus, not requiring too low a pressure may reduce the time required for this step. It should be noted that in embodiments where the smaller vacuum
30 chamber(s) are significantly smaller than the larger vacuum chamber, then any pressure difference between the two chambers should have a limited effect on

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the pressure in the larger vacuum chamber when the chambers are coupled together.

5 In some embodiments, said control circuitry comprises a signal input for receiving signals from said vacuum system, said control circuitry being configured to determine that said smaller vacuum chamber is to be evacuated from atmospheric pressure in response to a control signal received from said vacuum system.

10 In some embodiments, said control circuitry comprises a signal input for receiving signals from said vacuum system, said control circuitry being configured to determine that said smaller vacuum chamber has reached said predetermined pressure in response to a control signal received from said vacuum system.

15 In some cases the control circuitry may receive signals from the vacuum system and may control the valve system to couple or isolate the pumps in response to these signals. In other embodiments the control circuitry may detect changes in the vacuum system by detecting changes in the pumping system, such as changes in pressures within the pump or within a line to the pump, or changes in
20 current used by a pump motor and may use this to trigger the changing of the valves. The latter does not require the vacuum system to supply signals but will have the disadvantage of having some latency between the change and it being detected and thus, the periodic cycle may not be as rapid and the capacity of the vacuum system being pumped may therefore be slightly reduced.

25 In some embodiments, said valve system comprises one of a three-way valve or two two-way valves, said valve system being configured to isolate or connect said second vacuum pump from said larger vacuum chamber and to isolate or connect said second vacuum pump to a vacuum line pumped by said first
30 vacuum pump.

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In some embodiments, following shut down of said vacuum system and prior to said pressure cycling of said at least one smaller vacuum chamber, said control circuitry is configured to control said valve system such that said first and second vacuum pumps are in fluid communication with said larger vacuum chamber and
5 said first and second vacuum pump contribute to evacuation of said larger vacuum chamber from atmospheric pressure to an operational vacuum.

In addition to increasing the speed at which the smaller vacuum chamber(s) may be evacuated to a predetermined pressure the two pumps may be coupled to the
10 larger vacuum chamber in the case that this requires evacuation following perhaps a servicing of the vacuum system. This enables the evacuation of the larger vacuum chamber to be done more rapidly.

In some embodiments the larger vacuum chamber comprises a wafer transfer
15 chamber within a semiconductor processing system and the at least one smaller vacuum chamber comprises a load lock chamber for admitting or removing wafers from the transfer chamber.

A semiconductor processing system requires wafers to be admitted to various
20 processing chambers and a transfer chamber is used to facilitate the input and output of the wafers and the moving of the wafers between different processing chambers. The transfer chamber is relatively large and needs to be maintained at a relatively constant pressure and is used to protect the process chamber from variations in pressure and from contaminants. Load lock chambers are used to
25 input and remove wafers from the transfer chamber to the outside and are a potential source of contamination and variations in pressure. In order to increase the handling capability of such a system, it may be desirable to decrease the time required to periodically evacuate the load lock chambers. Providing a pumping system according to an embodiment for evacuating such a wafer transfer system
30 allows the wafer handling capability to be increased without unduly increasing the cost of the system.

In some embodiments, said vacuum system comprises two smaller vacuum chambers, one of said smaller vacuum chambers comprising a wafer entry chamber and said second smaller vacuum chamber comprising a wafer removal chamber.

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In some embodiments, said first and second vacuum pump have different pumping capacities, in some embodiments, said first vacuum pump has a pumping capacity of more than 1.5 times and up to twice the pumping capacity of the second vacuum pump.

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In some embodiments, the first vacuum pump has a pumping capacity of between 150 and 250m³/h while the second vacuum pump has a pumping capacity of between 80 and 150m³/h. Thus, when coupled together they provide a pumping capacity of between 230 and 400 m³/h. In this regard the pumping capacity is a capacity at full speed and is a value specific to a particular pump that will be selected for a particular system and will be within the range.

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In other embodiments said first and second vacuum pumps have a same pumping capacity enabling two identical smaller vacuum pumps to be used.

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They may for example each have a pumping capacity of 200 m³/h, which capacity when both are coupled together provides a capacity of 400 m³/h sufficient for the rapid evacuation of the smaller vacuum chamber.

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A second aspect provides a method of evacuating a vacuum system, said vacuum system comprising a plurality of vacuum chambers comprising at least one smaller vacuum chamber operable to cycle between a predetermined pressure that is below atmospheric pressure and atmospheric pressure, and a larger vacuum chamber; said method comprising: determining that a pressure within one of said at least one smaller vacuum chambers is to fall to said

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predetermined pressure within a first time period; controlling a valve system such that a first and second vacuum pump are isolated from said larger vacuum chamber and are in fluid communication with said smaller vacuum chamber;

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evacuating said smaller vacuum chamber to said predetermined pressure using both said first and second vacuum pumps; determining that said smaller vacuum chamber has reached said predetermined pressure; and controlling said valve system such that said second vacuum pump is isolated from said smaller vacuum
5 chamber and is in fluid communication with said larger vacuum chamber such that said second vacuum pump pumps said larger vacuum chamber.

In some embodiments, said steps of determining comprise receiving signals indicative of the condition from the vacuum system.

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In other embodiments, said steps of determining comprise detecting a change in condition of said pumping system, such as a change in pressure or current consumed by a motor.

15 Further particular and preferred aspects are set out in the accompanying independent and dependent claims. Features of the dependent claims may be combined with features of the independent claims as appropriate, and in combinations other than those explicitly set out in the claims.

20 Where an apparatus feature is described as being operable to provide a function, it will be appreciated that this includes an apparatus feature which provides that function or which is adapted or configured to provide that function.

BRIEF DESCRIPTION OF THE DRAWINGS

25 Embodiments of the present invention will now be described further, with reference to the accompanying drawings, in which:

Figure 1 shows a vacuum pumping system according to the prior art;

Figure 2 shows a vacuum pumping system according to an embodiment; and

Figure 3 shows a flow chart illustrating steps in a method according to an

30 embodiment.

DESCRIPTION OF THE EMBODIMENTS

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Before discussing the embodiments in any more detail, first an overview will be provided.

In semiconductor processing systems there may be a wafer transfer station to
5 insert and remove wafers from processing chambers. In order to preserve the
vacuum in the processing chambers, these transfer stations generally comprise a
wafer transfer chamber that is maintained at a low pressure and communicates
intermittently with the one or more processing chambers. There are also load
lock chambers which have a small volume and cycle relatively quickly between
10 atmosphere and a low pressure. In order to be able to evacuate the load lock
chambers to a desired vacuum in a short period of time a vacuum pump with a
relatively high pumping speed or pumping capacity may be required to evacuate
these chambers. A vacuum pump is also provided for maintaining the larger
transfer chamber at the required reduced pressure, this vacuum pump generally
15 has a smaller capacity.

In order to reduce the size of the pump required to provide the desired pressure
cycling speed of the load lock chambers, a vacuum system with control circuitry
and valves is provided that allows the vacuum pump used to maintain the
20 vacuum in the larger wafer transfer chamber to be periodically placed in fluid
communication with the load lock chamber such that it can assist in evacuating
this chamber. In this way the desired pumping speed may be achieved with a
combination of vacuum pumps allowing the vacuum pump that is generally used
for evacuating the load lock chamber to be smaller while still achieving the
25 desired evacuation speed.

In an example arrangement, for a design that requires say a pumping speed of
350m³/hr to achieve a particular pump down time in the load lock chamber a
pump with a power consumption of more than 1kw at ultimate would be required.
30 The size of pump required to maintain the transfer chamber at a required vacuum
might be significantly smaller at say 100 m³/hr. Embodiments propose to provide
the higher required pumping capacity by using the two pumps together with a

valve system allowing the smaller pump to be switched between pumping of the transfer chamber and pumping of the load lock chambers during the evacuation cycle. A signal from the tool can be provided to initiate this but an alternative solution may be for the control circuitry to detect the condition. In this way rather
5 than requiring a pump with a capacity of 350m³/hr and one with a capacity of 100m³/hr, a pump with a capacity of say 250m³/hr may be acceptable as the larger vacuum pump as when coupled with the smaller pump the desired total capacity would be provided. In some embodiments two pumps with a same capacity may be used, provided that the combined capacity provided the desired
10 pumping speed for the evacuation of the smaller vacuum chamber. In this example two pumps with a capacity of 200 m³/hr might be used.

In some embodiments, where the pump down times for the load lock chambers are different with one or one pair of chambers, perhaps the wafer entry chamber,
15 requiring rapid pump down and one or one pair of chambers, the wafer exit chambers for example, allowing a slower pump down, then the changeover function for the wafer transfer chamber pump is only needed for the rapid pump down and the vacuum pump dedicated for the load lock chambers can be used alone when the slower pump down is acceptable to the customer.

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In some embodiments, triggering of the changeover valve could be done by detecting a high current in the pump pumping the load lock chamber.

The changeover function can be achieved by a 3-way valve or 2 2-way valves in
25 combination.

Figure 1 shows a wafer transfer station 5 according to the prior art. The wafer transfer station 5 comprises two pairs of load lock chambers 30 one pair configured to receive a pair of wafers from a clean room wafer handling system 2
30 at atmospheric pressure via a robot 4 at atmosphere and to transfer them to the transfer chamber 40 at a reduced pressure using a low pressure robot 4, and the other to receive a wafer from the transfer chamber 40 at the reduced pressure

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and output to the wafer handling system 2 at atmospheric pressure again using the robots4. The load lock chambers 30 may be arranged in pairs and receive wafers in parallel.

- 5 The load lock chambers 30 are evacuated by a larger vacuum pump 10 and cycle between atmospheric pressure and a lower pressure at or close to the pressure in the transfer chamber 40. The load lock chambers 30 communicate with the wafer handling system or the transfer chamber via slit valves that open or close. Robot 4 does the wafer transfer in each direction.

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When the entry load lock chamber 30 is at atmospheric pressure, the vacuum system or tool opens the slit valves that communicate with the outside and a wafer is received from the wafer handling system 2. The slit valve is then closed by the tool control system and valve V1 is opened. Larger vacuum ump 10 then
15 evacuates the chamber 30 to a predetermined pressure and when this pressure is reached the control system of the tool controls the slit valves between the load lock entry chamber 30 and transfer chamber 40 to open and the wafers are moved into the transfer chamber 40. Valve V1 is then closed and the entry load lock chamber 30 is vented to atmosphere.

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When the wafer has been processed by the process chamber(s) 50 it is then returned back to the wafer handling system via the lower exit load lock chamber 30. The vacuum system or tool controls valve V2 to open such that the larger vacuum pump 10 evacuates the exit load lock chamber 30 and when there is a
25 wafer ready to be output and the pressure has reached the predetermined pressure the slit valves between the load lock chamber 30 and transfer chamber 40 are opened and the wafer is received in the exit load lock chamber 30. At this point valve V2 is closed and the load lock chamber is vented, the slit valves at the entrance opened and the wafer is removed.

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The transfer chamber 40 should remain throughout this process at a substantially constant low pressure and is evacuated by the smaller vacuum pump 20 which is connected to the transfer chamber 40 via valve V5.

- 5 Were the wafer transfer chamber to be required to increase its capacity and handle more wafers, then the limiting factor may be the speed at which the load lock chambers can be evacuated as they cycle between atmospheric pressure and a low pressure. In order to increase the speed of this cycle a larger vacuum pump 10 may be used, this would have a cost overhead. Alternatively, the
10 pumping capacity used to pump the load lock chambers 30 may be increased by a system according to an embodiment shown in Figure 2.

- Figure 2 shows a pumping system according to an embodiment connected to a wafer transfer system similar to that shown in Figure 1. The wafer transfer
15 system is configured in a similar way to that of Figure 1 such that the load lock chambers 30 cycle between atmosphere and a low pressure while the transfer chamber 40 is maintained at a substantially constant low pressure. In this embodiment, to provide an increased pumping capacity to the load lock chambers 30 and speed up their evacuation and thereby enable the wafer
20 transfer station to handle more wafers in a given time, a valve system V3 and V4 is provided. This valve system is controlled by control circuitry 25 and is configured to couple vacuum pump 20 to a load lock chamber during its evacuation such that vacuum pump 20 and vacuum pump 10 both contribute to the evacuation of this chamber. The valve system and control circuitry then
25 couple vacuum pump 20 to the transfer chamber 40 when the pump is not required to aid in evacuation of a load lock chamber 30. In this way vacuum pump 20 increases the speed at which the smaller load lock vacuum chambers 30 are evacuated while still providing sufficient pumping power to maintain the vacuum within the larger transfer chamber 40. In some cases, both the entry and
30 exit load lock vacuum chambers 30 are evacuated with the same time requirements and both use the two pumps for the evacuation process. In other embodiments, one of the load lock chambers, perhaps the entry load lock

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chamber has a faster evacuation time requirement than the exit load lock chamber and in this case, the control circuitry may control valves V3 and V4 to couple both pumps just to the entry load lock chamber during evacuation while the other exit load lock chamber is evacuated by a single pump.

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In this way, faster evacuation of the smaller load lock vacuum chambers and an increased capacity for the wafer handling station may be achieved by the use of control circuitry and an additional two valves as opposed to requiring an increase in size of vacuum pump 10.

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Figure 3 shows a flow diagram illustrating steps in a method according to an embodiment. This method may be performed by the apparatus of Figure 2. In an initial step S10 it is determined that a pressure within one of the at least one smaller vacuum chambers is to fall to a predetermined pressure within a first time period. This may be determined in response to a signal received from the vacuum system (process tool) or it may be determined by monitoring circuitry detecting a change in pressure or a change in load on the pump. In response to detecting this the valve system V3, V4 of Figure 2 is controlled by control circuitry 25 such that both the first and second vacuum pumps are isolated from the larger vacuum chamber 40 and are in fluid communication with the smaller vacuum chamber 30. In effect valve V3 is closed and V4 is opened and thus both pumps cooperate to evacuate the smaller vacuum chamber 30.

At step S30 the smaller vacuum chamber is evacuated to the predetermined pressure by both the first and second vacuum pumps 10, 20. At step S40 it is determined that the smaller vacuum chamber has reached the predetermined pressure. This may be in response to sensing circuitry associated with control circuitry 25 or it may be in response to a signal received from the vacuum system. When this is determined the valve system V3, V4 are controlled such that the second vacuum pump is isolated from the smaller vacuum chamber 30 and is in fluid communication and pumping the larger vacuum chamber 40. In the embodiment of Figure 2 that involves closing valve V4 and opening valve V3.

Although illustrative embodiments of the invention have been disclosed in detail herein, with reference to the accompanying drawings, it is understood that the invention is not limited to the precise embodiment and that various changes and
5 modifications can be effected therein by one skilled in the art without departing from the scope of the invention as defined by the appended claims and their equivalents.

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REFERENCE SIGNS

- 2 wafer handling system
- 4 robot
- 5 wafer transfer station
- 5 10 first vacuum pump
- 20 second vacuum pump
- 25 control circuitry
- 30 smaller vacuum chamber, load lock chamber
- 40 larger vacuum chamber, wafer transfer vacuum chamber
- 10 50 process chamber
- V1, V2, V5 vacuum system valves
- V3, V4 pumping system valves

CLAIMS

1. A vacuum pumping system for evacuating a vacuum system, said vacuum system comprising a plurality of vacuum chambers comprising at least one
5 smaller vacuum chamber operable to cycle between a predetermined pressure that is below atmospheric pressure and atmospheric pressure, and a larger vacuum chamber;
said vacuum pumping system comprising:
a first vacuum pump;
10 a second vacuum pump;
a valve system configured to selectively connect and isolate said first and second vacuum pumps with said plurality of vacuum chambers; and
control circuitry configured:
in response to determining that a pressure within one of said at least one
15 smaller vacuum chambers is to fall to said predetermined pressure within a first time period, to control said valve system such that said first and second pump are isolated from said larger vacuum chamber and are in fluid communication with said smaller vacuum chamber, such that both said first and second vacuum pumps contribute to evacuating said smaller vacuum chamber to said
20 predetermined pressure; and
and when said smaller vacuum chamber is at said predetermined pressure, to control said valve system such that said second vacuum pump is isolated from said smaller vacuum chamber and said second vacuum pump is in fluid communication with said larger vacuum chamber such that said second
25 vacuum pump pumps said larger vacuum chamber.
2. A vacuum pumping system according to claim 1, wherein said control circuitry is configured to control said valve system to isolate said second vacuum pump from said smaller vacuum chamber and to connect said second vacuum
30 pump with said larger vacuum chamber in response to determining that said smaller vacuum chamber has reached said predetermined pressure.

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3. A vacuum pumping system according to claim 1 or 2, wherein said vacuum system further comprises a second smaller vacuum chamber operable to cycle between a second predetermined pressure and atmospheric pressure within a second time period, said second time period not overlapping in time with
5 said first time period, wherein where a duration of said first and second time period are substantially the same, said control system is configured to control said valve system such that:

in response to determining that a pressure within said second smaller vacuum chambers is to fall to control said valve system such that said first and
10 second pump are isolated from said larger vacuum chamber and are in fluid communication with said second smaller vacuum chambers; and

when said second smaller vacuum chamber is at said second predetermined pressure, to control said valve system such that said second vacuum pump is isolated from said second smaller vacuum chamber and said
15 second vacuum pump is in fluid communication with said larger vacuum chamber such that said second vacuum pump pumps said larger vacuum chamber.

4. A vacuum pumping system according to any preceding claim, wherein said vacuum system further comprises a second smaller vacuum chamber operable to
20 cycle between a second predetermined pressure and atmospheric pressure within a second time period, said second time period not overlapping in time with said first time period, wherein where a duration of said second time period is more than 35% longer than a duration of said first time period said control system is configured:

25 in response to determining that a pressure within said second smaller vacuum chamber is to fall to control said valve system such that said first vacuum pump is in fluid communication with said second smaller vacuum chamber and said second vacuum pump is isolated from said second smaller vacuum chamber and is in fluid communication with said larger vacuum chamber.

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5. A vacuum pumping system according to claim 3 or 4, said vacuum system being such that said first vacuum pump is in fluid communication with said

smaller vacuum chamber during said cycle where said smaller vacuum chamber is being evacuated to a first predetermined pressure and to said second smaller vacuum chamber during said cycle where said second smaller vacuum chamber is being evacuated to said second predetermined pressure.

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6. A vacuum pumping system according to claim 5, said vacuum system being such that said first vacuum pump is isolated from said second smaller vacuum chamber during a period where said smaller vacuum chamber is being evacuated to said first predetermined pressure and is isolated from said smaller vacuum chamber during a period where said second smaller vacuum chamber is being evacuated to said second predetermined pressure.

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7. A vacuum pumping system according to any one of claims 3 to 6, wherein said first and second predetermined pressure comprise substantially a same pressure.

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8. A vacuum pumping system according to any preceding claim, wherein said control circuitry comprises a signal input for receiving signals from said vacuum system, said control circuitry being configured to determine that smaller vacuum chamber is to be evacuated from atmospheric pressure in response to a control signal received from said vacuum system.

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9. A vacuum pumping system according to any one of claims 1 to 7, wherein said control circuitry is configured to determine that said at least one smaller vacuum chamber is to be evacuated from atmospheric pressure in response to detecting changes in said pumping system, said changes including a change in pressure, or a change in current supplied to a motor of said first vacuum pump.

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10. A vacuum pumping system according to any preceding claim, said valve system comprises one of a three-way valve or two two-way valves, said valve system being configured to isolate or connect said second vacuum pump from

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said larger vacuum chamber and to isolate or connect said second vacuum pump to a vacuum line pumped by said first vacuum pump.

11. A vacuum pumping system according to any preceding claim, wherein
5 following shut down of said vacuum system and prior to said pressure cycling of said at least one smaller vacuum chamber, said control circuitry is configured to control said valve system such that said first and second vacuum pumps are in fluid communication with said larger vacuum chamber and said first and second vacuum pump contribute to evacuation of said larger vacuum chamber from
10 atmospheric pressure to an operational vacuum.

12. A vacuum pumping system according to any preceding claim, wherein said vacuum pumping system is for pumping a wafer handling system and said larger vacuum chamber comprises a wafer transfer chamber and said at least one
15 smaller vacuum chamber comprises a load lock chamber.

13. A method of evacuating a vacuum system, said vacuum system comprising a plurality of vacuum chambers comprising at least one smaller vacuum chamber operable to cycle between a predetermined pressure that is
20 below atmospheric pressure and atmospheric pressure, and a larger vacuum chamber;

said method comprising:

determining that a pressure within one of said at least one smaller vacuum chambers is to fall to said predetermined pressure within a first time period;

25 controlling a valve system such that a first and second vacuum pump are isolated from said larger vacuum chamber and are in fluid communication with said smaller vacuum chamber;

evacuating said smaller vacuum chamber to said predetermined pressure using both said first and second vacuum pumps;

30 determining that said smaller vacuum chamber has reached said predetermined pressure; and

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controlling said valve system such that said second vacuum pump is isolated from said smaller vacuum chamber and is in fluid communication with said larger vacuum chamber such that said second vacuum pump pumps said larger vacuum chamber.

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14. A method according to claim 13 wherein said steps of determining comprise detecting a change in at least one of a pressure or a current supplied to a pump motor in said pumping system.

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15. A method according to claim 13 or claim 14, wherein said steps of determining comprise receiving signals indicative of the condition from the vacuum system.