VENTED VACUUM SEMICONDUCTOR WAFER CASSETTE

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FIELD OF THE INVENTION

This invention relates to vacuum cassettes used for storing semiconductor wafers during production, and more particularly to a vacuum cassette that can be opened and resealed without the need for a vacuum load-lock chamber.

BACKGROUND OF THE INVENTION

The vacuum cassette in present use is a sealed container with a door providing access to the semiconductor wafers. When the cassette is in its normal operating mode with a vacuum within, the door cannot be opened to remove or load wafers. In the case of interfacing the vacuum cassette with a vacuum semiconductor processing system (vacuum processing system), the cassette is loaded into a vacuum load-lock interface integral with the process machine. This load lock is sealed and pumped down to a vacuum approximately the same as is inside the cassette, and the cassette door is then opened.

A gate valve in the load-lock is then opened and the wafers moved to and from the vacuum cassette to the interior of the vacuum processor as required. The wafers remain in a vacuum throughout the processing steps. When the wafer movement is complete, the gate valve and the cassette door are closed, and the load-lock is backfilled to ambient pressure with clean gas, usually air. The load-lock door can then be opened and the vacuum cassette removed. The interior of the vacuum processor remains in a vacuum throughout the process.

The above process is done automatically after the introduction of the vacuum cassette into the load-lock chamber. Vacuum gages are installed in appropriate locations to monitor the load-lock and process chamber conditions as required by a process sequencer/controller.

If it is desired to interface the vacuum cassette to a process that is not done in a vacuum, or if there is a circumstance where the semiconductor wafers must be at room ambient pressure, the cassette must be placed inside a vacuum load-lock chamber, which is then evacuated to a pressure comparable to the pressure inside the cassette. The cassette door may then be opened and the chamber and cassette backfilled with an appropriate atmosphere, usually clean air, to ambient pressure. Then the load-lock chamber may be opened, either with a gate valve or the loading door, and the wafers removed from or loaded into the open cassette.

BRIEF SUMMARY OF THE INVENTION

The invention relates to a vacuum chamber with one or more valves and ports which will allow the cassette to be evacuated, backfilled and opened to the surrounding atmosphere without the need for a vacuum load-lock chamber. In use, the vacuum cassette is locked into a fixture or cradle which automatically provides a sealed connection to the cassette port or ports, and mechanical or electromechanical connections to actuate the cassette mechanical or electrical valve or valves. The valves are opened and the vacuum backfilled at a predetermined rate with the appropriate atmosphere through the cassette port connection. When the internal pressure of the cassette is equal to the ambient pressure, as indicated by one or more vacuum/pressure gages, the cassette door may be opened and the semiconductor wafers removed or introduced without the use of a vacuum lock-load chamber.

When the wafer handling has been completed, the door of the vacuum cassette is closed and the cassette is pumped down to the desired level of vacuum, as indicated by the system vacuum/pressure gage, at a predetermined rate through the ports and valves.

The technical advance represented by the invention as well as the objects thereof will become apparent from the following description of a preferred embodiment of the invention when considered in conjunction with the accompanying drawings, and the novel features set forth in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a cross sectional view of a vacuum cassette with a single port;

FIG. **2** illustrates the vacuum cassette of FIG. **1** positioned at a work station;

FIG. **3** illustrates a cross sectional view of a vacuum cassette with two ports; and

FIG. **4** illustrates the cassette of FIG. **3** positioned at a work station.

DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

FIG. **1** is one embodiment of the invention. Cassette **10** has a chamber **11** with base **12**. Cassette **10** is positioned on a work station using pins that extend through openings **13** and **14**. The cassette chamber **15** is evacuated or filled with gas through channel **20**, valve **18** and port **17**. Valve **18** is opened or closed by a value actuator (not illustrated) coupled to valve lever **19**. Chamber **15** has two baffles **21** and **22** positioned at the chamber end of channel **20** to evenly distribute gases input to the chamber. Semiconductor wafers **16** are shown spaced apart in the vacuum chamber.

FIG. **2** illustrates the vacuum cassette of FIG. **1** mounted and secured to a work station. As illustrated, the vacuum cassette and valve position are in a backfill mode.

The cassette is mounted on a work surface **27** and secured to the work surface with hold-down clamps **23** and **24**. Hold-down clamps **23** and **24** pivot around a pin **23***a* (clamp **23**) and pin **24***a* (clamp **24**) to hold the base of the vacuum cassette down against the work surface **27**. Pins **13***a* and **14***a* position the cassette such that port **17** of the cassette matches port **17***a* of the gas/vacuum line.

The interface between openings **17** and **17***a* is sealed by Q-ring **30** so that when a vacuum is being pulled, or gas is introduced into the vacuum cassette, there will be no leakage from outside the cassette at the interface at **17** and **17***a*.

Valve **18** is actuated by valve actuator **26**. Actuator **26** is coupled to valve **18** by actuator lever **25** and valve lever **19**. Valve **18** is shown in the open position.

A rotary or other type valve **29** is used to open and close line **17***a* which connects the vacuum cassette **11** to a vacuum pump at **32** or to a source of backfill gas at **31**. As illustrated in FIG. **2**, the rotary valve is shown in the gas backfill position.

Operation of the vacuum cassette illustrated in FIG. **2** is as follows.