SYSTEMS AND METHODS FOR A SPRAY MEASUREMENT APPARATUS

FIELD

[0001] The present disclosure generally relates to a spray measurement apparatus, and in particular to systems and methods for a spray measurement apparatus capable of detecting liquid capture levels of one or more spray nozzles within a batch chemical process chamber for understanding spray distribution patterns.

BACKGROUND

[0002] Batch chemical process chambers for semiconductor wet chemical processing require a plurality of spray nozzles to spray a chemical onto a number of wafers stacked in an array inside the process chamber in a uniform manner. The malfunctioning of one or more spray nozzles or a misadjusted spray nozzle(s) can lead to non-uniformity in spray distribution, thereby preventing consistent or in-specification batch process completion. In addition, once an issue in the spray nozzle assembly is identified, it can be difficult and time-consuming to disassemble the batch process chamber to identify which nozzle(s) are malfunctioning and to take corrective action. As such, there lacks a system for easily and accurately monitoring and measuring spray distribution within a batch chemical process chamber.

[0003] It is with these observations in mind, among others, that various aspects of the present disclosure were conceived and developed.

SUMMARY OF THE INVENTION

[0003a] According to a first aspect of the present invention, there is provided a spray measurement system, comprising:

a rotor disposed within a batch chemical processing chamber, wherein the rotor is operable to rotate around a horizontal axis Z, wherein the rotor is operable to rotate in a clockwise or counterclockwise direction A and an opposite clockwise or counterclockwise direction B;

a spray measurement apparatus in operative association with the rotor, the spray measurement apparatus comprising:

a jig device , comprising a plurality of slots, wherein each of the plurality of slots is operable to receive a blocker plate; and

one or more channels corresponding with one or more of the plurality of slots, wherein each of the one or more channels is in operative association with a respective pressure transducer for measuring an amount of liquid collected in the one or more channels;

wherein the spray measurement apparatus is operable to be rotated between a vertical resting position and a predetermined testing angle by the rotor;

and;

a controller in operative association with the rotor, wherein the controller is operable to rotate the rotor around the horizontal axis Z, wherein the controller is operable to rotate the rotor in the clockwise or counterclockwise direction A and the opposite clockwise or counterclockwise direction B between the vertical resting position and a predetermined testing angle;

wherein the spray measurement apparatus is operable to be rotated to a predetermined testing angle and receive an amount of liquid sprayed by a spray nozzle array into the one or more of the channels, wherein a data collection interface is operable to record the amount of liquid collected in each of the one or more channels.

[0003b] According to a second aspect of the present invention, there is provided a method of measuring spray output using a spray measurement system, comprising:

rotating a rotor in operative association with a spray measurement apparatus having a plurality of channels, wherein the rotor and spray measurement apparatus are rotated in a clockwise or counterclockwise direction A along a horizontal axis Z, wherein the rotor and spray measurement apparatus are rotated from a vertical position to a predetermined testing angle;

spraying an amount of liquid from a fixed spray nozzle array at the spray measurement apparatus, wherein a volume of liquid from the fixed spray nozzle array is collected into one or more of the plurality of channels of the spray measurement apparatus;

rotating the rotor in operative association with the spray measurement apparatus in an opposite counterclockwise or clockwise direction B along the horizontal axis Z such that the spray measurement apparatus having collected an amount of the liquid is returned to a vertical position; and

measuring the volume of liquid in one or more of the plurality of channels.

CLAIMS

What is claimed is:

1. A spray measurement system, comprising:

a rotor disposed within a batch chemical processing chamber, wherein the rotor is operable to rotate around a horizontal axis Z, wherein the rotor is operable to rotate in a clockwise or counterclockwise direction A and an opposite clockwise or counterclockwise direction B;

a spray measurement apparatus in operative association with the rotor, the spray measurement apparatus comprising:

a jig device , comprising a plurality of slots, wherein each of the plurality of slots is operable to receive a blocker plate; and

one or more channels corresponding with one or more of the plurality of slots, wherein each of the one or more channels is in operative association with a respective pressure transducer for measuring an amount of liquid collected in the one or more channels;

wherein the spray measurement apparatus is operable to be rotated between a vertical resting position and a predetermined testing angle by the rotor;

and;

a controller in operative association with the rotor, wherein the controller is operable to rotate the rotor around the horizontal axis Z, wherein the controller is operable to rotate the rotor in the clockwise or counterclockwise direction A and the opposite clockwise or counterclockwise direction B between the vertical resting position and a predetermined testing angle;

wherein the spray measurement apparatus is operable to be rotated to a predetermined testing angle and receive an amount of liquid sprayed by a spray nozzle array into the one or more of the channels, wherein a

data collection interface is operable to record the amount of liquid collected in each of the one or more channels.

2. The system of claim 1, wherein the spray nozzle array remains in a fixed position angled above the spray measurement apparatus, wherein the spray nozzle array is operable to spray the amount of liquid at the spray measurement apparatus.

3. The system of claim 1, wherein each of the plurality of blocker plates prevent liquid from entering a corresponding slot of the plurality of slots, and wherein the manual removal of blocker plates allows liquid to enter a corresponding slot of the plurality of slots.

4. The system of claim 1, wherein the spray measurement apparatus is secured within the rotor using first and second side bar portions formed along respective opposite sides of a casing.

5. The system of claim 1, wherein the controller is operable to record and analyze information collected by the data collection interface.

6. The system of claim 1, wherein a malfunctioning spray nozzle of the spray nozzle array is identified by measuring an amount of liquid collected in each of the plurality of channels.

7. A method of measuring spray output using a spray measurement system, comprising:

rotating a rotor in operative association with a spray measurement apparatus having a plurality of channels, wherein the rotor and spray measurement apparatus are rotated in a clockwise or counterclockwise direction A along a horizontal axis Z, wherein the rotor and spray measurement apparatus are rotated from a vertical position to a predetermined testing angle;

spraying an amount of liquid from a fixed spray nozzle array at the spray measurement apparatus, wherein a volume of liquid from

the fixed spray nozzle array is collected into one or more of the plurality of channels of the spray measurement apparatus;

rotating the rotor in operative association with the spray measurement apparatus in an opposite counterclockwise or clockwise direction B along the horizontal axis Z such that the spray measurement apparatus having collected an amount of the liquid is returned to a vertical position; and

measuring the volume of liquid in one or more of the plurality of channels.

8. The method of claim 7, further comprising:

configuring one or more channels for testing of one or more of spray nozzles by adding or removing one or more of a plurality of blocker plates, wherein each of the plurality of blocker plates is configured to be disposed within a respective slot of a slot assembly of the spray measurement apparatus, wherein a respective slot is associated with one of the plurality of channels such that the amount of liquid sprayed by one or more spray nozzles at that respective slot is collected at one of the plurality of channels.

9. The method of claim 7, wherein the method of measuring spray output is repeated, wherein each repetition of the method of measuring spray output is at a different testing angle.

10. The method of claim 9, wherein a malfunctioning spray nozzle from the spray nozzle array is identified by measuring the volume of liquid collected in each of the plurality of channels across one or more testing angles.

11. The method of claim 7, wherein the volume of liquid in a respective channel of the spray measurement apparatus is measured by measuring the amount of pressure in the respective channel using a respective pressure transducer, wherein the amount of pressure in the channel corresponds to the volume of liquid collected in the channel.

12. The method of claim 11, wherein a data collection interface in operative communication with the pressure transducers is operable to record and analyze data pertaining to the amount of pressure in each of the plurality of channels.

13. The method of claim 7, wherein a controller in operative communication with the rotor is operable to rotate the rotor, thereby rotating the spray measurement apparatus.