Real time contamination monitoring device development in the gas/chemical delivery line – Hong, Joo-Pyo

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Process gases with vapor or liquid phase as well as gas phase may experience alteration in itself or be contaminated and condensed in the delivery line to the process chamber. Powders would be generated and stuck to the fluid pipe, filters, valves, and etc. And they result in as particles or defects on the substrates in semiconductor, LCD, LED, and OLED manufacturing (Fig.1).

From the monitoring viewpoint, QMS (quadruple mass spectroscopy) or OES (optical emission spectroscopy) can be used for the monitoring during the process at the process chamber. And, ISPM (in-situ particle monitoring) or SPOES (self-plasma optical emission spectroscopy) can be applied in the pumping line next the process chamber. However, none of detection device is available in the delivery line before the process chamber due to its size, energy, cost, and etc.

We propose simple device with lighting and sensing in order to predict contamination of the fluid or the tube wall. A light source facing an optical sensor over the transparent tube where fluid flows emits light with specific wavelength, and the sensor will reveal values according to the fluid properties or contamination aspect (Fig. 2).

For some general purpose gases, it showed constant voltage output regardless of the flow rates (Table 1). However, operating temperature influenced the data (Table 2).

Smoke and moisture in the air lowered the value due to its concentration, and the figure finds its place as the contamination weakens (Fig. 3). When a liquid inserts, sensor output haunts due to bubbles at the beginning (Fig. 4).

Test results for some liquid and solid media insisted different numbers each other contrary to the gases. Some reasoning for the difference between gas and liquid will be performed based on the refractive index, hue, or haze of the fluid.

Smooth fluid flow in the device, sealing, and leakage of toxic, explosive, or corrosive gases were considered in hardware design. Real time data relay module from the device to manufacturing equipment or fab host computer was developed.

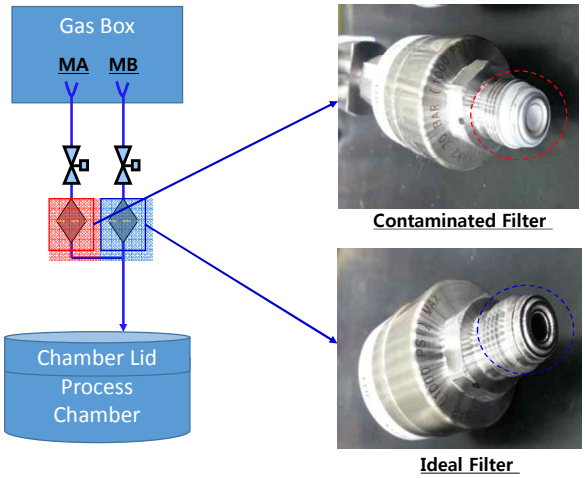

Figure 1 Contaminated filter in the delivery line

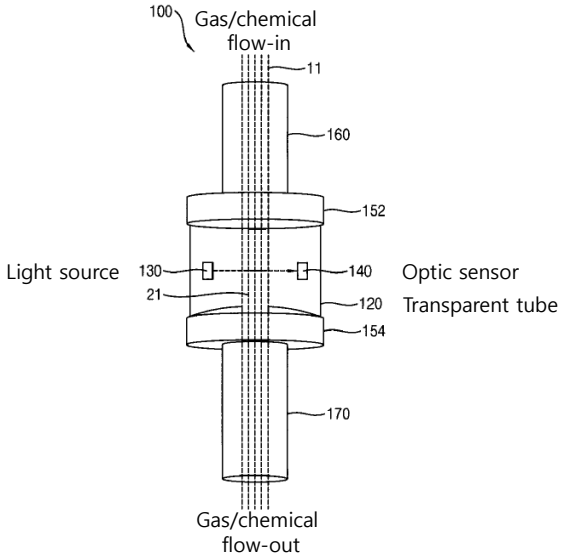

Figure 2 Contamination detecting device

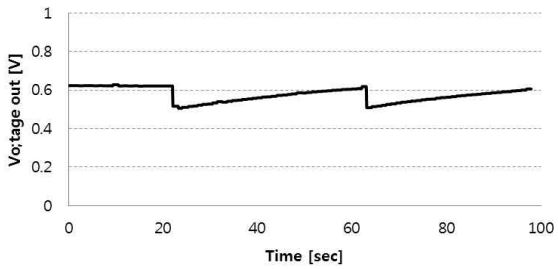

Figure 3 Sensor output lowered due to smoke and returns as contamination weakens

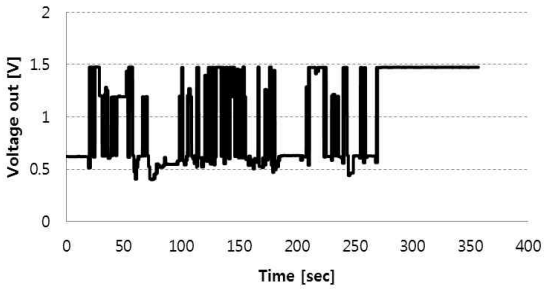

Figure 4 Voltage haunts when liquid inserts

Table 1 Voltage out according to gas species and flow rate at ambient temperature

flow/gas	Ar	CO2	O2	He
5 SLM	0.619	0.62	0.62	0.619
10 SLM	0.62	0.62	0.619	0.62
15 SLM	0.619	0.619	0.62	0.62
20 SLM	0.619	0.619	0.62	0.62

Table 2 Voltage out at the temperature of 100°C

flow/gas	Ar	CO2	O2	He
5 SLM	0.387	0.386	0.387	0.387
10 SLM	0.387	0.387	0.387	0.386
15 SLM	0.386	0.387	0.387	0.387
20 SLM	0.387	0.387	0.387	0.387