Manifold Sampling System for Semiconductor AMC Monitoring

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A contaminant-free environment is critical in high-throughput semiconductor manufacturing. All areas of the semiconductor fabrication plant (fab) need to be carefully monitored, from cleanrooms and plenum to the sub-fab spaces.

A manifold valve system, also known as manifold sampling system, is an important component in the semiconductor manufacturing process, specifically in the context of airborne molecular contamination (AMC) monitoring. This system monitors gases from different source points, ensuring that processes are carried out under optimal conditions, preventing contamination of the materials being produced.

AMC monitoring is critical in semiconductor manufacturing. Tiny amounts of airborne contaminants have a significant impact on product quality and performance. It is essential to have precise control over the flow of gases and chemicals used in the manufacturing process, and this is where the manifold valve system comes into play.

Manifold valve systems increase sampling efficiency, enabling one analyzer to track several sources. The speed at which each source or port is measured is an inverse function of the number of ports.

TOFWERK's multiport valve system combined with the AMC analyzer provides ultra-fast sampling (milliseconds). Each port is sampled within seconds, covering up to six different chemical ionization methods for a wide range of AMC classes. TOFWERK's manifold system is easily attached to AMC monitors. The number of sampling points can be customized by adding modules to the six available ports as shown in Figure 1. The ultra-fast instrument response allows sampling of each port to be as short as 10 seconds without memory effects between ports, Figure 2 [1].

[1] Depending on the physicochemical properties of the contaminant, these could be sampled with a delay due to the interaction of the contaminant with the sampling lines. This effect is independent of the analyzer and completely related to the volatility, absorption, and adsorption of the contaminant.

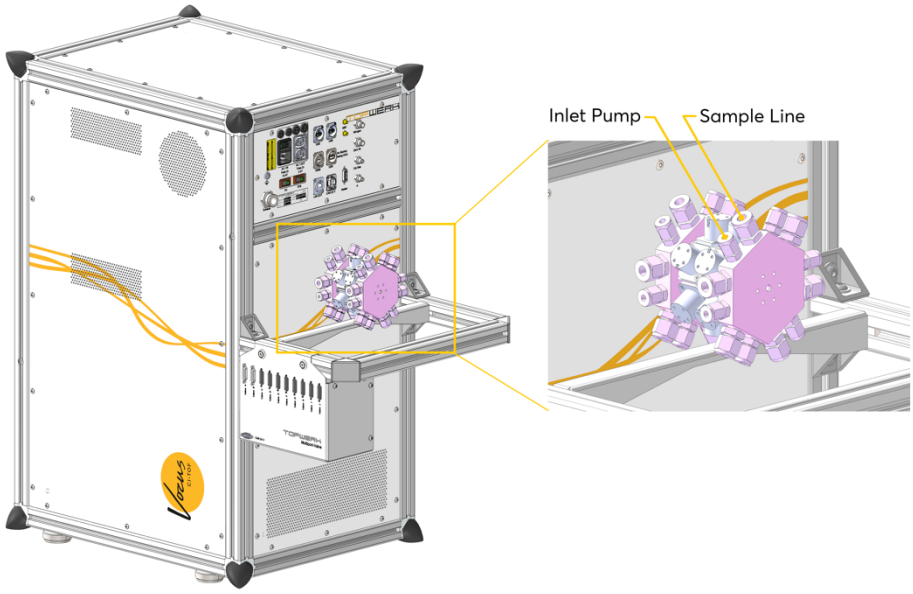

***Figure 1**. Schematic of TOFWERK's multiport valve assembled with an AMC monitor.*

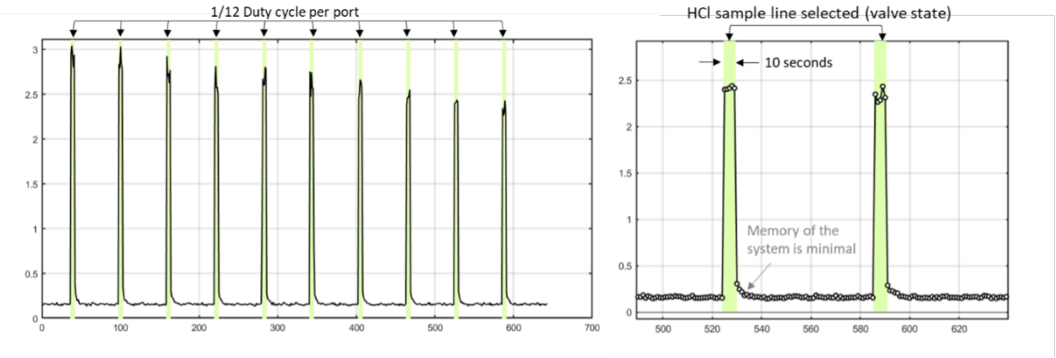

***Figure 2**. Duty cycle per port using twelve ports (left) and fast time response between ports (right).*

TOFWERK's manifold system has been tested in fabs, performing analysis of timed excursion events from various locations. During tests, the system accurately identified AMCs present, including acids, solvents, and bases. Examples of excursion events are shown in Figures 3 and 4 for PGMEA and Cl_2 respectively.

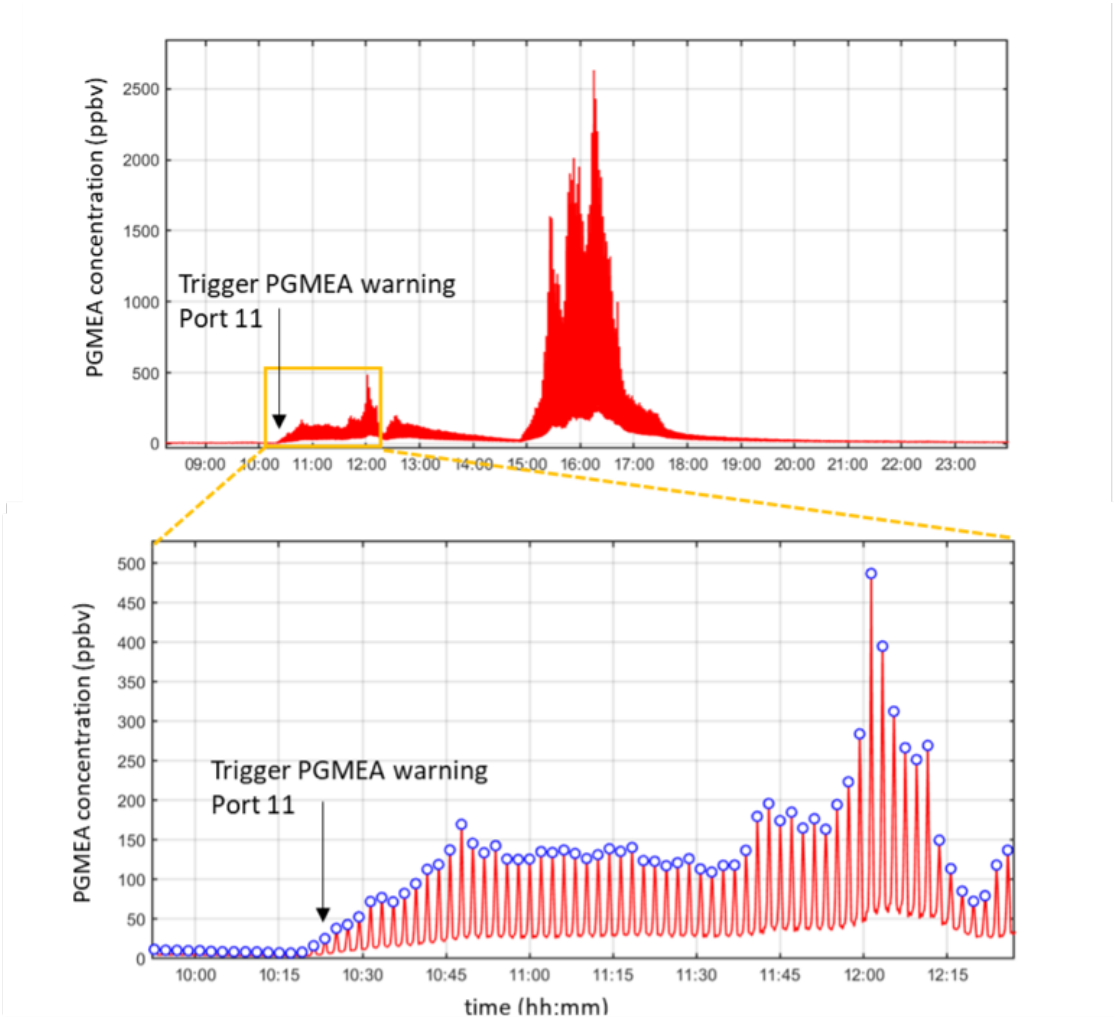

Figure 3. *Top: Time series for PGMEA showing excursion events in one location (Port 11). Bottom: zoom-in in one of the excursion events where an alarm was triggered.*

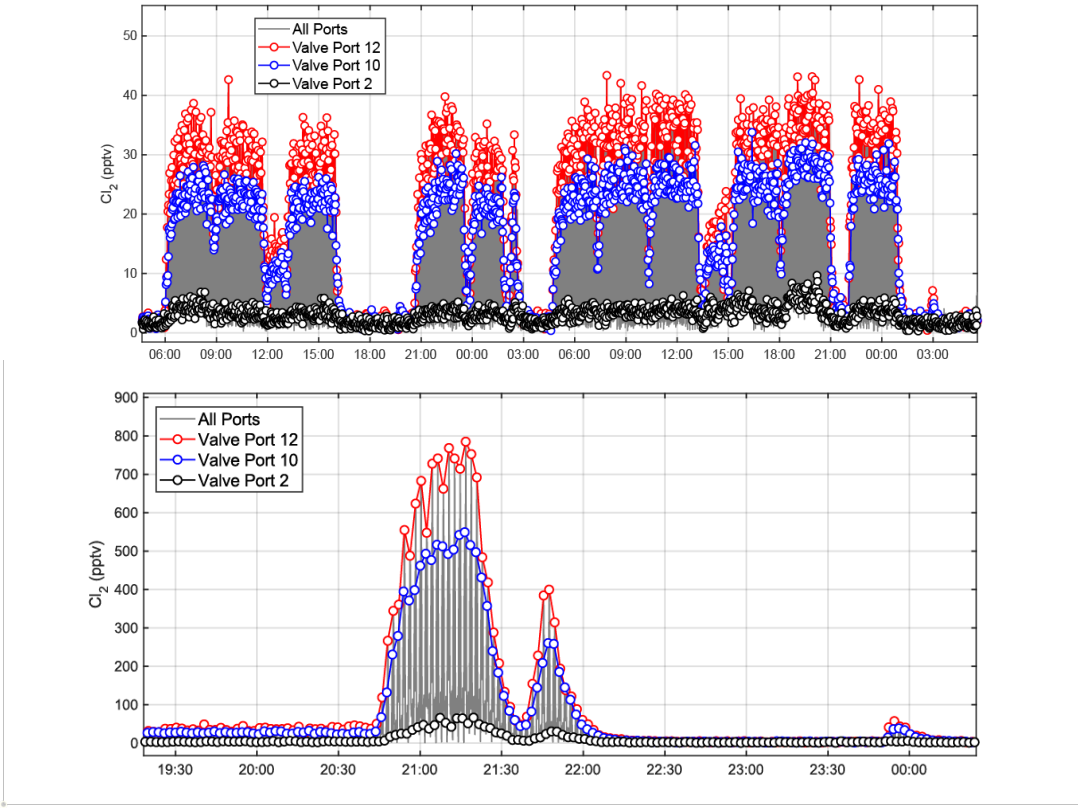

Figure 4. *Chlorine (Cl_2) measurement in a fab. Top: recurring events with low concentrations ~50 pptv with measurement points at 3 different locations highlighted. Grey lines are the 12 port switching in a cycle of 2 minutes. Bottom: Excursion event reaching concentrations of almost 1 ppb in port 12 and 500 ppt in port 10, while other locations in the fab were minimally impacted.*

In this application note, we demonstrate use of a multiport valve system to increase the throughput of monitored locations and help to identify processes or events that decrease production yield.

Contact

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