

Cleanroom Contamination Monitoring with ClearFab AMC Monitors

Carla Frege
TOFWERK, Switzerland

Cleanrooms are facilities where the purest environmental conditions are required for industrial production or research. Cleanrooms design aims to maximize production rates and yields for sensitive materials (microelectronics) and processes (wafer fabrication) [1]. To meet stringent requirements, fast and sensitive monitoring of airborne molecular contaminants (AMCs) is essential.

The need for a high degree of cleanliness in fabs has forced adoption for industry standards. The adopted ISO 14644-1 standards range from ISO 1 to ISO 9 compliance, according to the quantity and size of particles permitted per volume of air.

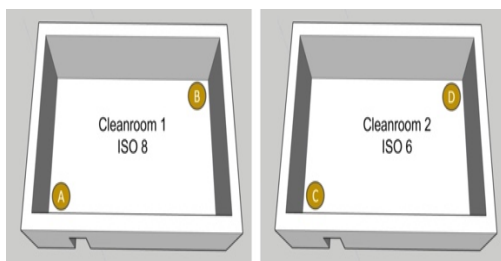


Figure 1. Schematic of sampling points in two cleanrooms. Points A and B were in cleanroom 1 (ISO 8) while points C and D in cleanroom 2 (ISO 6).

Experimental Set Up

A ClearFab AMC Monitor was placed in two fab cleanrooms meeting ISO 6 and ISO 8 respectively. In each cleanroom, direct air samples were taken from two different points, making a total of four sampling points as shown in Figure 1.

Results

The rapid response time of the monitors allowed for immediate assessment of the air quality at each sampling point, accurately detecting process failures and the presence of undesirable contaminants.

Figure 2 shows measured concentrations of acetone, acetic acid and cyclopentanone from the four sampling points. The concentration of acetone was found to be constant at all sampling points, while cyclopentane concentration varied between cleanrooms. Higher concentrations were observed in Cleanroom 1, consistent with its ISO 8 class. Acetic acid concentration varies not only between rooms but between sampling points, suggesting differences in processes or ventilation.

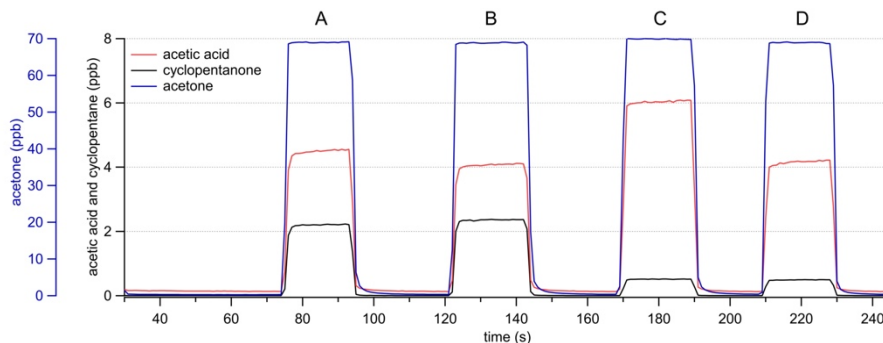


Figure 2. Sampling in each point from the cleanrooms. The trends in concentration of cyclopentanone (black) show a clear difference between the two cleanrooms while acetic acid (red) shows slight concentration differences in the location inside each clean room; finally, acetone (blue) had a constant concentration independently of the sampling point.

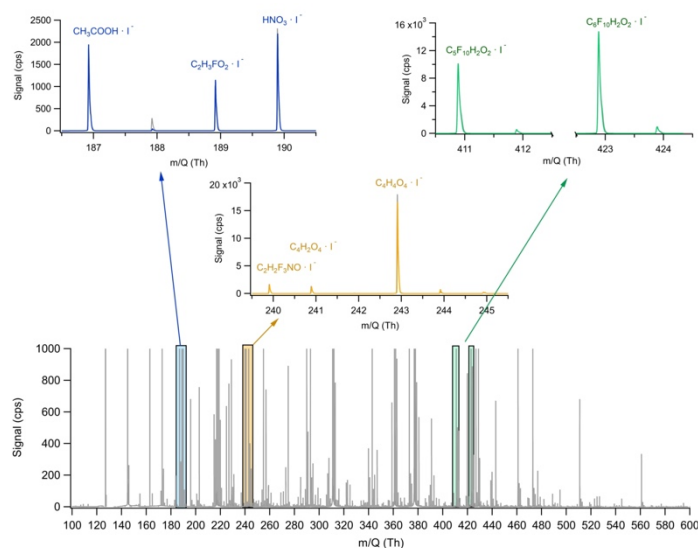


Figure 3. Spectrum from sampling point B. Examples of molecules found in the low (blue), middle (orange) and high (green) mass range. Tentatively assigned molecules: acetic acid (CH_3COOH), fluor acetaldehyde ($\text{C}_2\text{H}_3\text{FO}_2$), nitric acid (HNO_3), trifluoroacetamide ($\text{C}_2\text{H}_2\text{F}_3\text{NO}$), acetylanedicarboxylic acid ($\text{C}_4\text{H}_2\text{O}_4$), maleic acid ($\text{C}_4\text{H}_4\text{O}_4$), Per- and polyfluoroalkyl substances, PFAS ($\text{C}_5\text{F}_{10}\text{H}_2\text{O}_2$ and $\text{C}_6\text{H}_{10}\text{H}_2\text{O}_2$).

The versatility and sensitivity of ClearFab AMC Monitors allows for the simultaneous monitoring of different AMC categories. Figure 3 shows the spectrum captured in sampling point B with some molecules that exemplified the detection.

References

[1] Den et.al., Journal of The Electrochemical Society 153(2):G149-G159, 2005, DOI:10.1149/1.2147286

Contact

sales@tofwerk.com
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