TOFWERK Aim Reactor Provides Fast, Easy-to-Interpret Results for Semiconductor AMC Monitoring

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PTR Ionization and Fragmentation of Key Analytes

A longstanding problem in chemical ionization mass spectrometry is the use of high-energy ionization techniques, which can cause fragmentation during the ionization process and result in difficult-to-interpret results. While proton transfer reaction (PTR) ionization can be a powerful analytical tool, fragmentation is a serious shortcoming for the analysis of key airborne molecular contaminants (AMC) in the semiconductor fabrication (fab) environment.

To address this problem, PTR-based AMC monitors have implemented multiple switched ion chemistries as well as energy scans in the reaction chamber. These feed into complex mathematical matching models to deconvolve the separation of isobars and isomers and better handle fragmentation. However, this process is error prone and slow, often taking five or more minutes to generate one datapoint. This model-based approach to AMC measurements also struggles to handle compounds not pre-programmed into the database, which results in erroneous concentrations or compound distributions under changing fab conditions. When new compounds are introduced to the fab environment, the deconvolution algorithms may incorrectly interpret the compounds and concentration in air because new or interfering fragments convolute the observed mass spectrum in unpredictable ways.

TOFWERK Aim Reactor Advantages

A far more effective solution to the measurement of AMCs in the fab environment is to use an alternative ionization method to PTR - the TOFWERK Aim Reactor. Using VUV light to generate ultra-pure and selective reagent ions in a dedicated chamber results in a simple-to-interpret mass spectrum. With adduct formation instead of high-

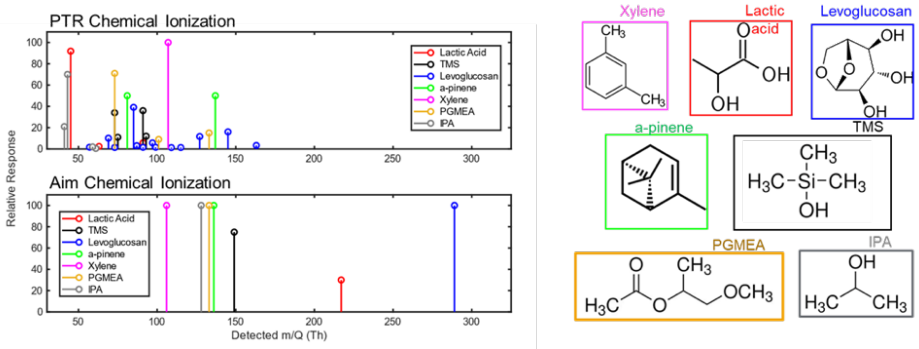

***Figure 1**. Compounds susceptible to fragmentation are measured using both a PTR Reactor (top) and Aim Reactor (bottom) coupled with a TOFWERK Semicon AMC Monitor. The bottom panel, generated by the instrument using the Aim Reactor, shows a much simpler and easier-to-interpret mass spectrum due to soft ionization technology.*

energy reactions like with PTR, this ultra-soft, virtually fragmentation-free ionization does not require the use of complex computer algorithms. Instead, the Aim Reactor only requires calibration information to convert the mass spectrum into accurate concentrations. This means that concentrations can be reported in real time without the need to cycle many ionization energies and reactor conditions. Figure 1 shows how this soft ionization approach results in negligible fragmentation compared to measurements of the same compounds using the PTR Reactor. The instrument using PTR measured up to 13 peaks for just a single compound, creating a congested and convoluted mass spectrum, whereas measurements produced with the Aim Reactor created just a single peak.

Summary

The TOFWERK Aim Reactor provides easy-to-interpret results that can be generated in real time and are extremely reliable and reproducible thanks to the robust design principles of TOFWERK time-of-flight (TOF) mass spectrometers. These powerful instruments, coupled with the soft ionization of the Aim Reactor, can efficiently report accurate concentrations based on exact mass analysis, separate potentially interfering isobars due to their high available mass resolving power, and measure real-time isotopic distributions. The TOFWERK AMC Monitor (ABC configuration) not only offers the capability to switch reagent ions, but also polarities on the order of milliseconds, allowing for up to six selective ion chemistries in real time (less than three seconds).

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