On-Line Fast Analysis of AMC from ppt to % levels in Clean Air Room

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To ensure people's safety and a good repeatability of industrial process, near real-time risk management and the continuous monitoring are crucial. In the semiconductor fabrication process, particle control is an essential part. Clean room technology, which relies on the use of HEPA and ULPA filtration, has in the past exclusively focused on the control of micro- and nano-particles. Nevertheless, as a consequence of device reduction, Airborne Molecular Contaminations (AMCs) has also become a key detractor of yield. Especially in photolithography area where a variety of molecules can impact the process (ammonia, Silicon Volatile organic compounds, acids) [1]. The nature and concentration of AMCs can be different depending on the chemical process and can also vary rapidly. These AMCs can impact the process and reduce the lifetime of equipment. Among the AMCs, silicon compounds are very problematic because they combine with oxygen to create amorphous silicon dioxide on optical surfaces, leading to non-reversible lens damages. These optical tools are very expensive and need to be protected [2].

The concentrations of VOCs are usually assessed using sorbent tubes or canisters for the sample collection. The samples are then taken to a laboratory for GC–MS analyses. Some of these methods are well established and have been published by the US Environmental Protection Agency (US EPA) as compendium methods, which are known as TO-14A or TO-15 methods. These methods for sampling and analysis are inherently for time-averaged concentrations. Although rapid sampling is possible when using canisters, it is too expensive to analyse a large number of samples if real-time concentration trends need to be profiled [3].

These methods are not efficient to monitor punctual industrial events. Therefore, there is a need to analyse precisely and continuously gas process in air with an instrument designed for industrial use.

Chromatotec® has developed a new and simple analytical system for sampling and determination of AMCs in air by using Thermal Desorption (TD) technique followed by Gas Chromatography (GC) equipped with two detectors: a flame ionisation detector (FID) and a Mass spectrometer (MS). The analytical system called AirmoSCAN Xpert, his last very sensitive online TD-GC-MS-FID instrument for VOC identification and quantification. With such solution, it is now possible to track more than 100 VOCs and to monitor molecules listed in PAMS 56, TO14, TO15 as well as specific Silicon VOCs used in clean air room processes. Identification of compounds and quantification can be performed from ppt, to % levels. AirmoSCAN Xpert analyser encompasses a specific trap to concentrate the sample (from 100 ml up to 1000 ml), a metallic chromatographic column for separation of chemicals and two detectors: a new micro FID and electron impact simple quadrupole MS for quantification and identification.

Figure 1: airmoTWA analytical system

A Chromatography Data System is vital for efficient and reliable operation of any modern on-line and continuous chromatography acquisition system. VistaMS, which has been developed at Chromatotec®, offers a unique solution for simple continuous identification and quantification of molecules from complex samples and data transfer of your system analyses. This software, included in all Chromatotec® MS systems, can intercompare and validate results obtained using multiple detectors. In ambient air systems, data from two FIDs and one MS are timestamped, saved and analysed to provide the most reliable and precise results. Analytical results can be easily re-processed changing all parameters of the TD-GC-MS-FID system (retention times, response factors, volume sampled, etc.). Automatic communication with NIST library allows for confirmation of identification of complex samples. Physical parameters of the TDGC and MS as well as all analytical results can be transferred using Modbus protocol.

In *Figure 2* is an example of MS chromatogram analysing 10 ppb of PAMS 56 cylinder. All molecules are identified and quantified automatically. Also, Vista MS allows for confirming the identification of molecule using NIST library and to identify unknown molecules.

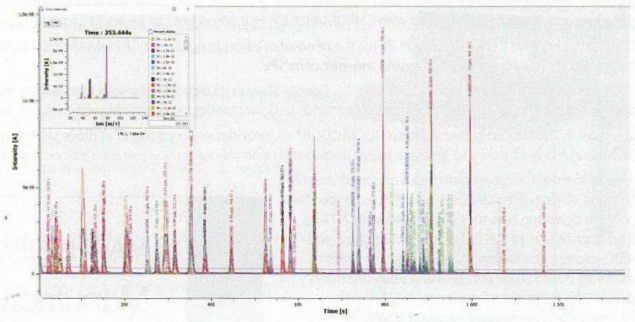

Figure 2: MS chromatogram with confirmation of identification using NIST library.

The system includes a multiplexing system which can analyse up to 16 streams with length from few meters up to 100 meters. Therefore, one system can analyse the contamination at different locations of the production room. With cycle times ranging from few seconds (direct analysis with MS) up to 30 minutes (with TD-GC-MS-FID), the system is perfectly suited for mapping of AMCs in clean air room. An embedded calibration system is also included and allows for daily automatic calibration of all detectors. Air and Hydrogen generators are also supplied with the system.

AirmoSCAN Xpert is a user-friendly system which allows non- specialised people to access expert analytical results. The system is a turnkey solution designed for monitoring 24 hours a day, 7 days a week and does not require the use of any gas cylinder [4].

References

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