

# Maintaining Bulk Gas Purity in Semi Applications

MKS Instruments provides an effective and highly accurate solution for analysis and measurement to ensure bulk gas purity for point-of-use and supplier sites

## Introduction

The electronics industry requires high purity, not only in their bulk gas supply ( $N_2$ ,  $O_2$ ,  $H_2$ , etc.), but also for specialty gases like  $NH_3$ ,  $NF_3$ ,  $SiH_4$ ,  $N_2O$  and many others. These gases are commonly used in the manufacture of semiconductors, photovoltaic cells and flat panel displays where reducing and controlling the impurities in the gases can greatly aid in contamination control. Even though a gas supplier can create and certify gas to a specific purity level, that does not guarantee that the cylinder, regulator or other gas handling equipment will not degrade or decompose prior to use, creating additional impurities.

Point-of-use purifiers are being used today to remove water and other contaminants from high purity gases prior to use; employing a real-time process monitor after the purifier verifies the impurities are below a specified acceptable value. Even though point-of-use purifiers are popular they do not supplant the need for a high purity gas supply. Purifiers are capacity limited and under certain conditions can even evolve more impurities than what were in the original gas supply. The ability to monitor gas purity prior to and during the manufacturing process will greatly reduce and control the level of gas contamination. Bulk gas purity is critical to both gas suppliers and semiconductor facilities and each have their own set of challenges impacting cost, yield and performance.

## MKS products solve key Bulk Gas Analysis challenges with high performance solutions in:

- Real time, on-line purity analysis
- Trace ppb impurity detection
- Continuous monitoring with set trigger thresholds

## Challenges in Gas Purity Monitoring

Monitoring bulk gas has a number of challenges including the presence of moisture, the use of highly corrosive gases and the need for readings in real time to safeguard the process. Additionally, the analyzer must be able to identify a range of impurities and their concentration. Even with the best suppliers, there can be low levels of moisture in the source gas, additionally, many semiconductor manufacturing processes rely on very reactive and caustic gases. The combination of harsh gas and the presence of moisture can corrode and damage some analyzers. Finally, some analyzers cannot be used in real-time, and require periodic calibration to certified standards and gases. All of

these challenges impact the productivity and quality of the process.

For the gas supplier, there are a number of other specific challenges including certification of impurities such as  $H_2O$  and  $CO_2$  at ppb levels, identification of other impurities that may not be monitored as standard practice, as well as material compatibility and degradation issues.

Generating gas at the point-of-use requires continuous process monitoring of impurities for potential upsets such as a compressor leak, identification of purifier breakthrough, as well as verification of impurities at ppb levels.

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## MKS Solutions

### MultiGas™ 2032 FTIR Purity Analyzer

The MultiGas 2032 Purity Analyzer is a real-time, fully calibrated, Fourier Transform Infrared (FTIR) system for monitoring trace impurities in both bulk and specialty gases. Most major bulk gas suppliers use the MultiGas purity analyzer to certify their gas purity to ppb levels for H<sub>2</sub>O, CO, CO<sub>2</sub> and CH<sub>4</sub> which are almost always present. The MultiGas 2032 can typically also perform analysis for other impurities such as N<sub>2</sub>O, HF, HCl, NO, NO<sub>2</sub>, NH<sub>3</sub> at the same time. And the MultiGas 2032 high performance analyzer gas cell performs well in both moist and corrosive environments.



Designed and constructed to meet the demands of ppb level moisture detection, the MultiGas 2032 Purity Analyzer has been equipped with an integrated purge gas purification panel. Upon initial installation, special electronics and heaters assist with the removal of trace moisture entrained

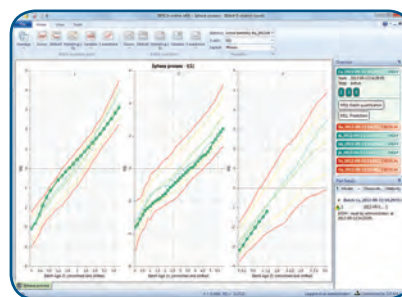
within the optical compartment and on the wetted sample surfaces. Once the surface moisture has been removed, the integrated heaters and purge gas manifold help maintain a steady state low moisture background. The gas cell assembly includes highly polished stainless steel or Dursan® coated internal surfaces as well as welded lines and VCR fittings to reduce surface tension and potential dead volumes where moisture may reside.

Once the analyzer has been installed and the internal moisture removed, the system is ready for continuous, high purity gas and process monitoring, requiring only an instrument purge gas flow. This analyzer uses a novel algorithm that does not require a daily zero, often required in other optical techniques. This removes the chance of moisture contamination when switching gas streams from the sample gas to the zero gas.

The MultiGas Purity analyzer can be configured with a choice of detectors to perform analysis within the full mid-infrared spectral range down to a narrow band IR range, and depending on the configuration selected, the analyzer can run unattended 24 hours / 7 days a week.

### Data Analytics

To further reduce the chance of unexpected contamination, process control monitoring can be used. The FTIR spectral



residual can be integrated with MKS SIMCA®-online software, a real-time prediction system that provides a complete set of interactive and visual monitoring tools to ensure that batch and

continuous operations run smoothly. With SIMCA software to monitor the FTIR spectral residual, users can predict when a system upset has occurred or whether one or more of the key impurities are out of bounds. SIMCA can pre-set trigger thresholds which can stop or modify the process within minutes of an upset.

MKS has a broad product portfolio of gas analysis solutions for your most challenging gas purity and process control requirements. Partnering with MKS can greatly reduce potential gas stream contamination as well as provide peace of mind by validating the purity of supply and point-of-use gases.