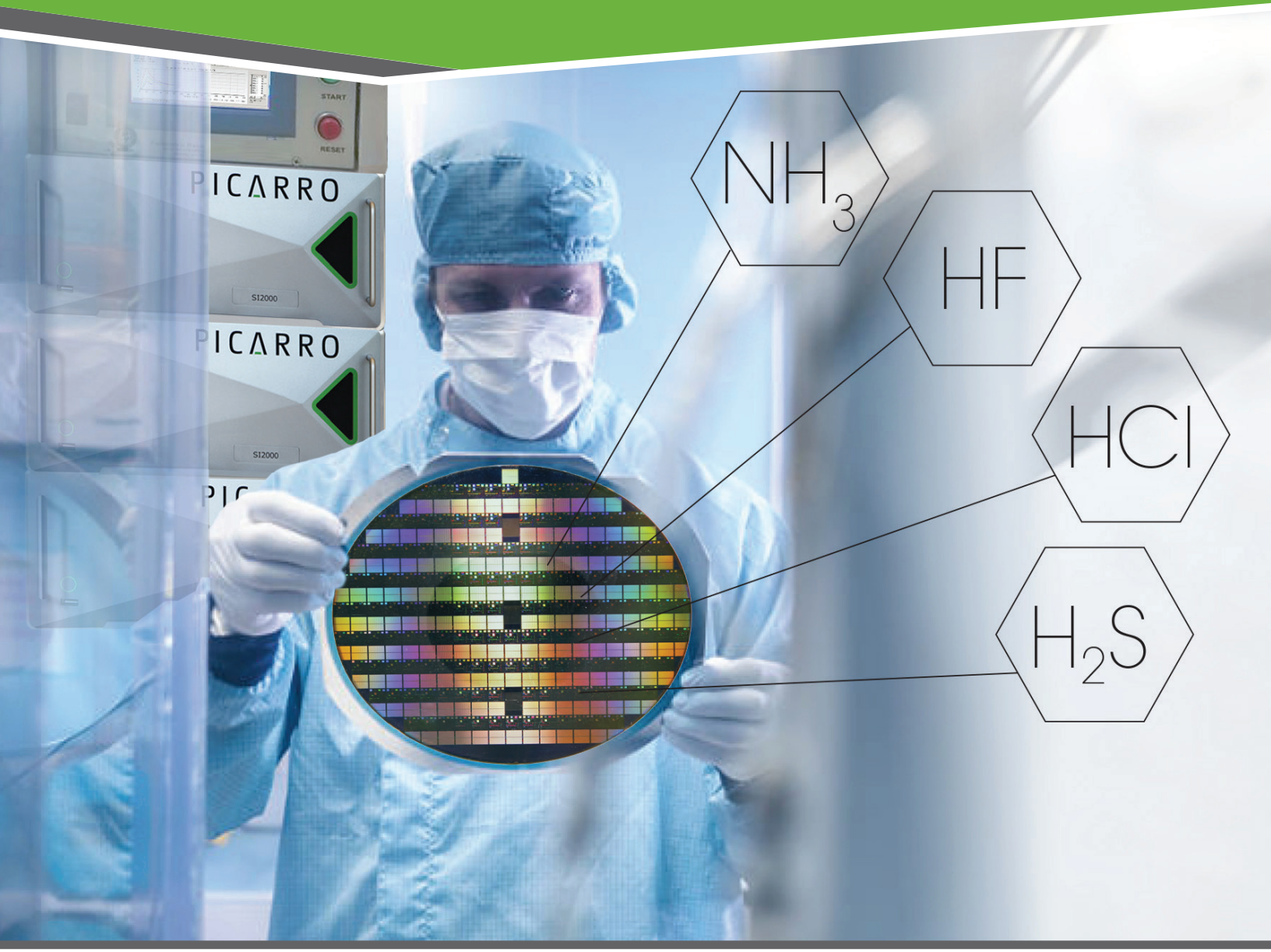
Inorganic Gas Monitoring for AMC Control

with Picarro SI2000 Series Analyzers



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The Search For Better AMC Control

From 2012 through 2015, the 17 International Technology Working Groups of the industry consortium known as the ITRS (International Technology Roadmap for Semiconductors), identified the major challenges facing the semiconductor industry. Their report calls for a critical need to improve production efficiency & yield, and active control of the process, and minimizing downtime and cost of maintenance. The 2015 report on AMC notes that, "the legacy analyzers used in monitoring contamination in most FAB processes are too slow, not sensitive enough, and are too expensive to maintain." In its detailed section on more than 60 contaminants known to proactively address Health & Safety, by choosing measurement technologies that are statistically optimized for process control based on **cost of ownership (CoO)**.

"The legacy analyzers used in monitoring contamination in most FAB processes are too slow, not sensitive enough, and are too expensive to maintain." -2015 ITRS Report

Meeting the goals of yield enhancement and production improvement will require preemptive warning capabilities through real-time process monitoring and to cause device failure across the industry, the working group recommended the monitoring of several of the critical inorganic ions such as Fluoride and Chloride by **Cavity Ring-Down Spectroscopy**. CRDS is the patented and now proven-in-use analytical technique deployed by Picarro in our new SI2000 Series laser analyzers.

Why Laser Spectroscopy?

AMC monitoring of inorganic gases has traditionally been performed by ion chromatography, ion mobility spectroscopy, and gas chromatography. With the introduction of laser-based spectroscopy techniques, the potential for increased sensitivity, accuracy, data-acquisition speed, and response time to critical **parts-per-trillion (ppt)** concentration levels are now being realized in real-time process applications for cleanroom, FOUP and fab equipment monitoring.

The new SI2000 Series analyzer spectrometer from Picarro is a reliable, easy-to-use, compact spectrometer, optimized for long-term stability and low maintenance. CRDS laser analyzers do not require field calibration, exhibit virtually zero downtime and negligible consumables cost, and require **less than 15 minutes** to accomplish a complete analyzer validation annually. Enclosed in a standard rack, and paired with a multi-port sequencer and datalogger, these analyzers are currently installed in major fab locations, monitoring cleanroom air and FOUPs to the lowest concentrations possible in real-time. The analyzers operate for months without user interaction, with trending data continuously archived to the analyzer's internal hard drive and automatically exported at regular intervals via industry standard protocols.

Today, Picarro SI2000 Series analyzers perform AMC monitoring of HF, HCl, NH_3, H_2O and H_2S. The future holds great promise in the development of additional gas applications by variations of CRDS products. Picarro will continue to drive innovative solutions for additional inorganic gases, as well as new organic AMC contaminants in subsequent models of the SI2000 Series analyzers.

International Technology Roadmap for Semiconductors (2015). Retrieved from http://www.itrs2.net/

Real-time AMC Process Monitoring Systems

Real-time continuous measurement of inorganic AMC requires experience and expertise by both the Analyzer Manufacturer and the System Integrator. Picarro engineers and scientists support our system integration partners with more than 10 years of expertise in air sampling requirements and instrumentation design. We work with our partners to select the best sample sequencers, materials of construction, valve and pumping techniques for the critical transport of samples from the widely varying environmental pressures and temperatures of the locations and equipment inside the fab's. This critical retention of sample integrity from the origin of a sample through to the detection cell inside the analyzer is the key to producing stable, accurate and reproducible trace gas measurements in the parts-per-trillion concentration range.

How It Works

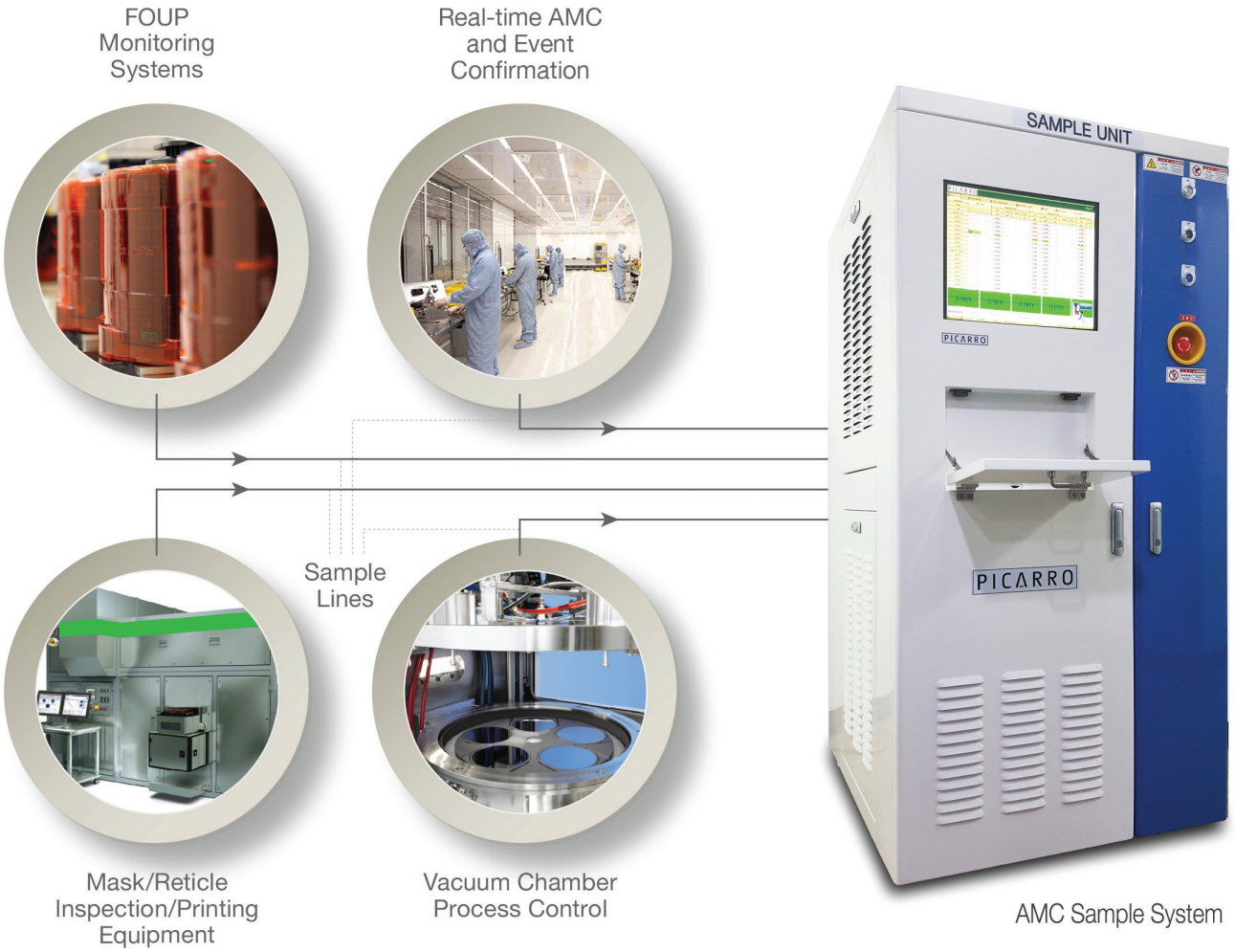


Figure 1. For real-time AMC process monitoring, 16, 24 or 32 sample ports draw air from various fab locations to an enclosed rack of laser analyzers located in or near the cleanroom. The Picarro CRDS analyzers stream continuous trace gas concentration data from their operating software into the rack-mounted datalogger or PLC. The second-by-second trending data is then communicated directly to the control room operators, enabling preemptive warning of potentially damaging levels of contaminants.

Our Commitment To Semi Industry Standards

Every company makes a commitment to quality and compliance, but the Picarro team is taking this commitment to a higher level. Our factory meets all of the requirements for manufacturing scientific instruments here in the USA (FDA and IEC Laser Safety Standards, CE Compliance, etc.) In addition, we're committed to meeting our customers' Industry Standards for the analyzers and applications they perform in their facilities. For our Semiconductor customers, this means the implementation of applicable SEMI performance and safety standards, and the IEC performance standards for process analyzers. Our customers can be confident that their Picarro laser analyzers are performing to specifications defined by their own industry experts.

SEMI S2 - Environmental, Health, and Safety Guideline for Semiconductor Manufacturing Equipment

SEMI E10 - Specification for Definition and Measurement of Equipment Reliability, Availability, and Maintainability

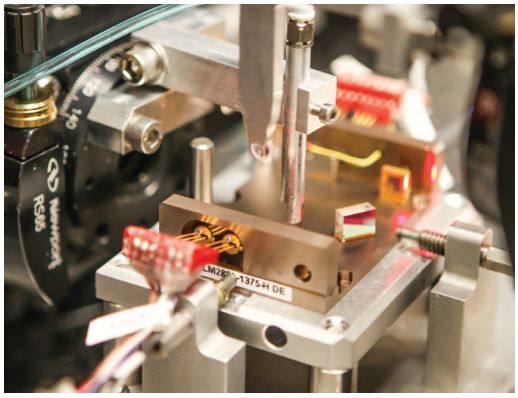
SEMI C10 - Guide for Determination of Method Detection Limits

IEC 61207-1 - Expression of Performance of Gas Analyzers

IEC 61207-7 - Expression of Performance of Gas Analyzers

IEC 60825-1 - Safety of Laser Products

IEC 61010-1 - Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use



Our Company

Picarro is a leading provider of trace gas analyzers for a wide variety of air monitoring applications. Our PhD scientists, optical engineers and technicians design and manufacture AMC, FOUP and fab equipment process metrology instruments in our factory located in the heart of Silicon Valley, California. Our operators know the importance of maintaining strict cleanroom standards while we affix, align, and assemble our precision optical components in our own ISO Class 6 facility. That critical knowledge and understanding resonates throughout our organization and translates into a passion to serve our customers with the very best solutions to preemptively warn of airborne contamination ingress.

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