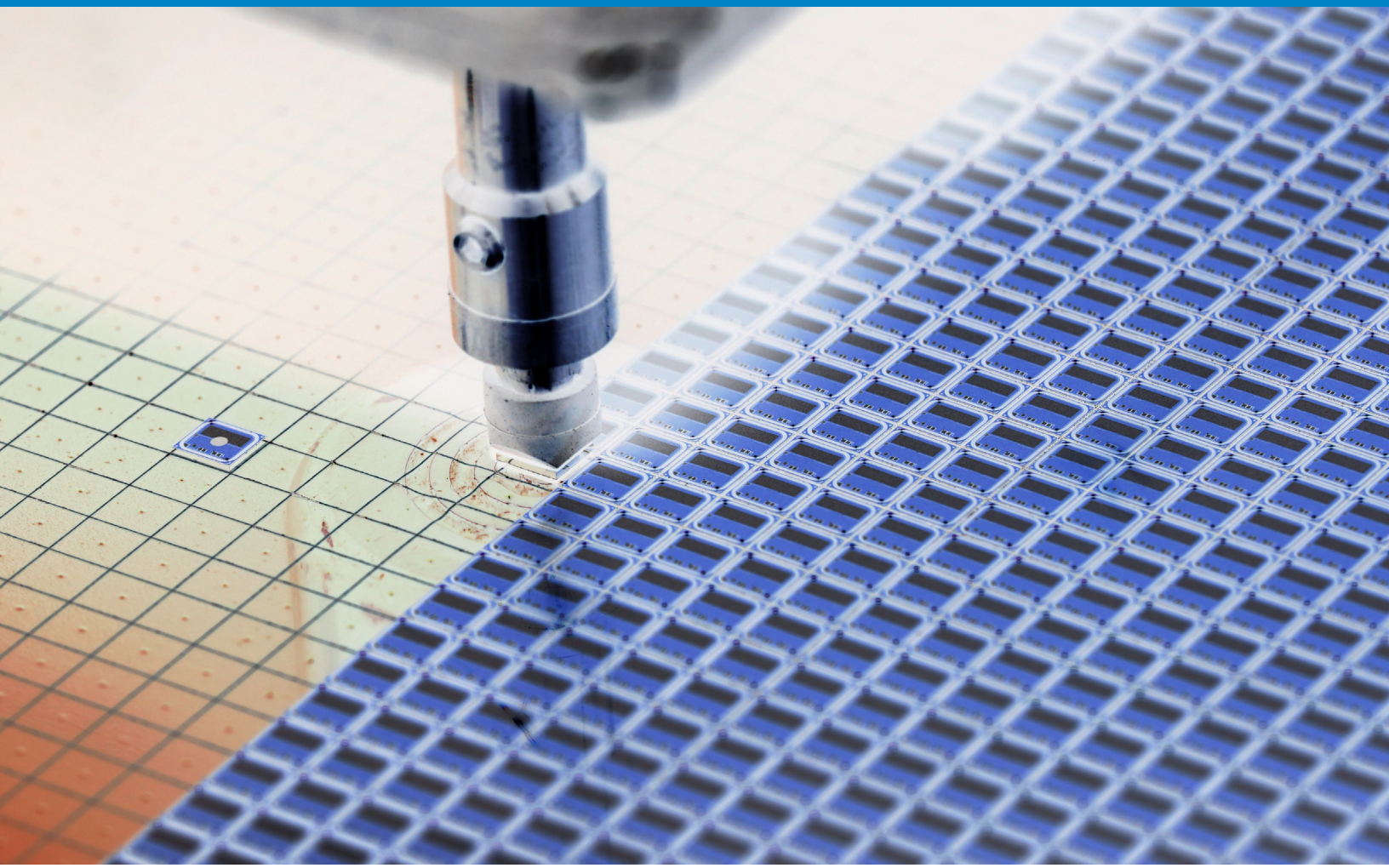

Minimize the Environmental Impact of Semiconductor Manufacturing with Real-Time Online Trace Metals Analysis

Semiconductors play an essential part in the electronics industry and act as the brains in the majority of processing, computing and control applications in a wide range of consumer and industrial markets. The semiconductor manufacturing industry is highly dependent on water of which large volumes are required that must be treated to ultrapure standards using resource intensive technologies. The semiconductor manufacturing process also generates significant volumes of wastewater that contains heavy metals and toxic solvents. Due to the hazardous nature of these liquids, semiconductor manufacturing facilities are regulated under local, state and U.S. EPA wastewater requirements for effluent discharge, including those under the Clean Water Act, and must meet specific limitations for these priority pollutants.

Given the intense use of water in semiconductor manufacturing, sustainable water use has become a priority for leading semiconductor manufacturers such as Intel that have pledged to meet ambitious environmental sustainability goals. One of these goals is Intel's commitment to restore 100% of global water use to mitigate the unpredictable impact of climate change on water supplies that are essential to their operations. Intel is an industry leader in disclosing water usage and reports on use by location with real-time data on www.exploreintel.com.

Initiatives by the semiconductor industry to improve the efficiency of wastewater treatment processes are very timely. As the demand for semiconductors increases, larger volumes of water will be required, and even greater volumes of wastewater will be generated.

To meet their discharge goals, semiconductor manufacturing facilities must either have their wastewater hauled to a liquid hazardous waste disposal site, which is extremely costly, or install a wastewater treatment scheme that effectively separates the contaminants from the water so it can be legally discharged into sewer systems or reused.

Ion exchange (IX) is one effective method to treat wastewater laden with heavy metals. During operation, the contaminant of concern accumulates on the IX resin and eventually it reaches saturation; needing to be regenerated. An optimal IX treatment process aims to extend the useful life of the resin while avoiding running the system to exhaustion. On the flip side, early regeneration wastes time, system capacity, and most importantly, expensive reagents all the while producing more waste.

Regenerating IX resins more efficiently and being able to more accurately determine the need for resin treatment and replacement can bring about operational savings and improved quality (e.g., avoiding undertreating or overtreating). This optimization philosophy reduces the substantial cost of regeneration and minimizes rinse water and associated labor.

Online monitoring of the IX system regeneration process is needed to control the performance of the system and ensure compliance that cannot be achieved using traditional analytical methods. The ability to obtain high-frequency data on the contaminant of concern allows for accurate and reliable measurement, assessment and validation of the IX process, and ultimately ensures regulatory compliance.

The Solution

To reduce its environmental impact, the semiconductor industry is actively searching for new ways to optimize water consumption and improve the quality of wastewater effluent by using sustainable treatment systems which integrate real-time, continuous trace metal analysis.

MetalGuard™ is the first fully automated online trace metals analyzer designed to monitor municipal and industrial water and wastewater. The system, manufactured by AMS, provides real-time, multi-stream analysis for a range of trace metal contaminants and delivers accurate and reliable results (up to 1 ppb) in less than 30 minutes. When integrated into a wastewater remediation control strategy, MetalGuard™ serves as an essential element to ensure regulatory compliance with trace metal standards.

Case Studies

Contaminant of Concern — Arsenic

A manufacturer of laser diodes made from Gallium Arsenide substrates (GaAs) wafers needed to attain reliable and continuous measurements of arsenic concentrations in its wastewater to ensure discharge compliance. The manufacturer selected the novel online arsenic monitor, MetalGuard™, which uses Anodic Stripping Voltammetry (AVS) technology to measure arsenic concentrations in real-time.

Through continuous and reliable data on influent and effluent arsenic levels in real-time, the analyzer provided confidence and the ability to create trend data to evaluate the effectiveness of the waste treatment system as it was being used and refined.

In addition to ensuring IX system performance and regulatory compliance, the use of the online MetalGuard™ Arsenic analyzer and IX system delivered process knowledge and significant cost savings compared with the prior treatment scheme. With the invaluable real-time arsenic data, a closed loop system was developed which resulted in a 90% reduction in water use compared with the previous open loop system.

Contaminant of Concern — Copper

A semiconductor manufacturer installed an IX system to better manage its wastewater. However, the manufacturer faced challenges associated with copper analysis using traditional colorimetry methods. An online copper analyzer, MetalGuard™ that uses advanced direct voltammetry was installed to improve the safety and quality of measurements for copper wastewater streams while reducing operational and maintenance costs.

The high-frequency data from the online MetalGuard™ analyzer identifies influent and effluent copper levels for accurate and reliable measurement, assessment and validation of the IX process scheme.

To optimize the IX system and avoid premature IX regeneration, system saturation and breakthrough, the material balance data for copper that is built into the MetalGuard™ analyzer could be used to predict IX resin regeneration or replacement. The online analyzer is equipped with software that can track the IX system load and based on the implemented IX system regeneration cycle, the system can then track actual capacity and "predict" the next IX resin regeneration cycle. This helps avoid premature media replacement and minimizes potential breakthrough risk.

The Value of Real-Time Data

The ability to obtain real-time, continuous trace metal data is integral to significantly reducing treatment costs and ultimately lowering operational costs in semiconductor manufacturing facilities. As demand for semiconductors continues to grow and regulations for water use and wastewater management become more stringent, online monitoring systems like MetalGuard™ will become even more crucial. Online monitors are needed to validify the wastewater treatment process efficacy and mitigate the environmental impact of semiconductor manufacturing facilities.

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