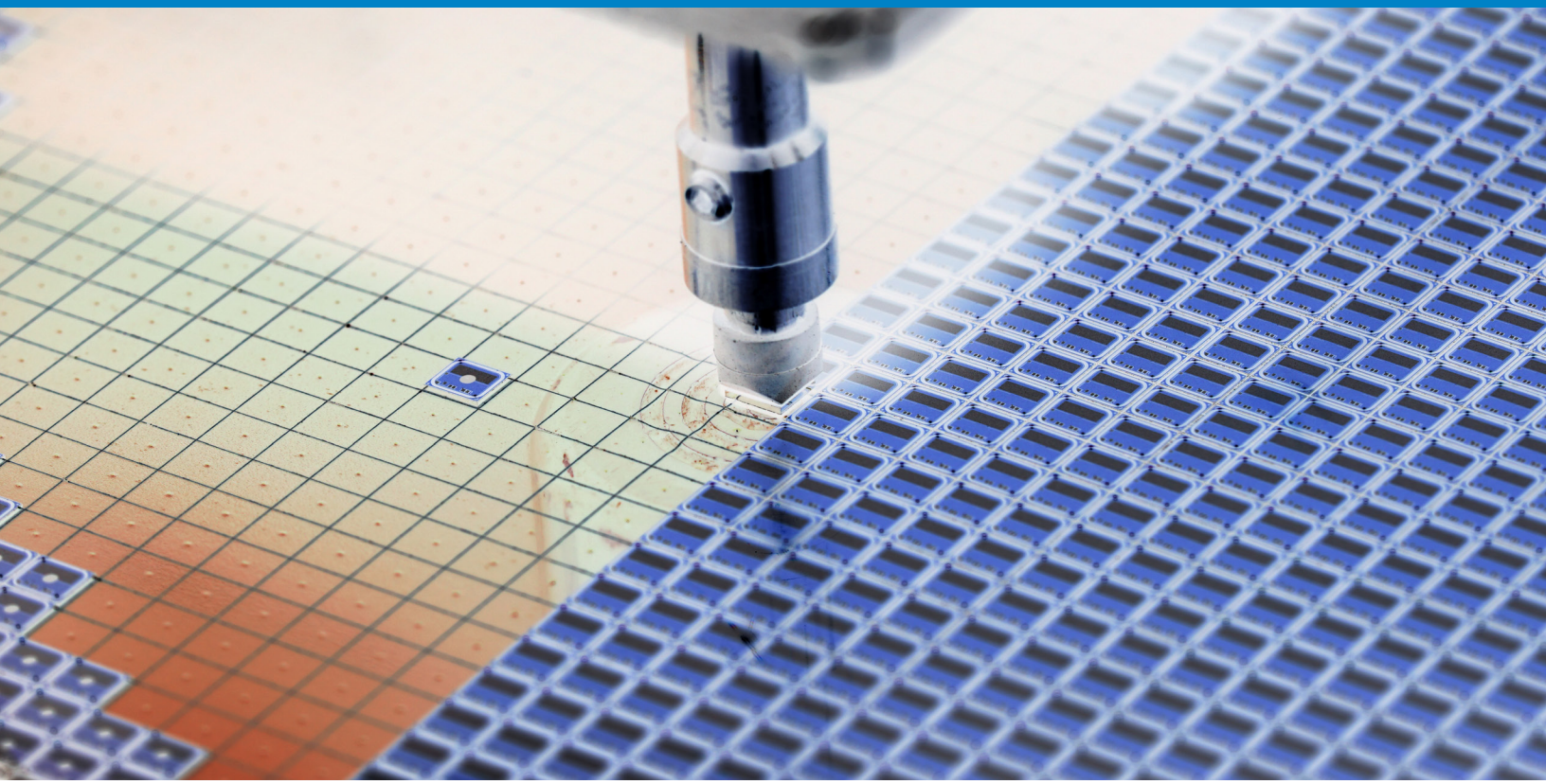

Minimize the Environmental Impact of Semiconductor Manufacturing with Real-Time Online Trace Metal Analysis

Semiconductors play an essential part in the electronics industry and act as the brains behind most processing, computing, and control applications across a wide range of consumer and industrial markets.

The semiconductor manufacturing industry is highly dependent on water, requiring large volumes 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 must comply with 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 this industry, sustainable water use has become a priority for leading semiconductor manufacturers. Initiatives by the semiconductor industry to improve the efficiency of wastewater treatment processes are increasingly important. As demand for semiconductors continues to grow, larger volumes of water will be required, and even greater volumes of wastewater will be generated.

To meet discharge requirements, semiconductor manufacturing facilities must either haul wastewater to hazardous waste disposal sites, 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, contaminants accumulate on the IX resin until it reaches saturation and requires regeneration. 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.

Improving the efficiency of IX resin regeneration and more accurately determining when treatment or replacement is needed can deliver operational savings and improved performance (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.

Additionally, by adopting sustainable treatment systems that integrate real-time, continuous trace metal analysis, the semiconductor industry can reduce its environmental impact, optimize water consumption and improve wastewater effluent quality.

The Solution

The online MetalGuard™ trace metal analyzer from AMS provides real-time analysis of a wide range of contaminants of concern such as arsenic and copper. The fully automated system delivers accurate and reliable results with sensitivity down to 1 ppb and a measurement time between 30 minutes and less than two hours. 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 wafers needed to attain reliable and continuous measurements of arsenic concentrations in its wastewater to ensure discharge compliance. The manufacturer selected the online MetalGuard analyzer to measure arsenic concentrations in real-time.

Through continuous and reliable data on influent and effluent arsenic levels, the MetalGuard 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 delivered process knowledge and significant cost savings. With the invaluable real-time arsenic data, a closed-loop system was developed, resulting 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, it faced challenges associated with copper analysis using traditional colorimetry methods. To address this issue, an online MetalGuard analyzer was installed to improve the safety and quality of measurements for copper wastewater streams while reducing operational and maintenance costs.

High-frequency data from the MetalGuard analyzer identified influent and effluent copper levels for accurate and reliable measurement, assessment, and validation of the IX process scheme.

To optimize system performance and avoid premature IX regeneration, saturation, or 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 critical for reducing treatment costs and lowering operational expenses in semiconductor manufacturing facilities. As demand for semiconductors continues to grow and regulations governing water use and wastewater management become more stringent, advanced online water quality monitoring systems like MetalGuard will become even more crucial. Online trace metal analyzers are essential for validating wastewater treatment performance and minimizing the environmental impact of semiconductor manufacturing.

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