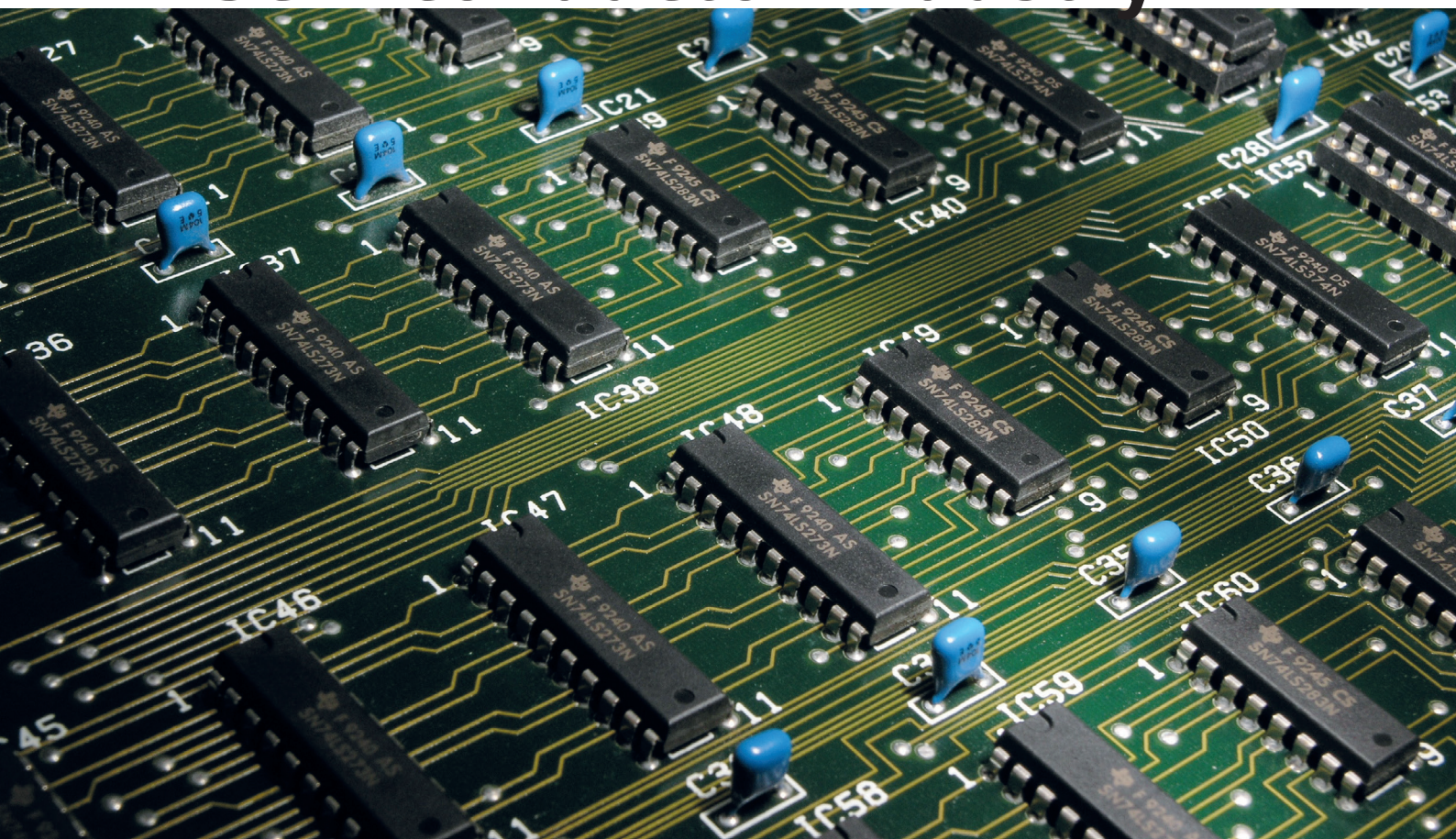


Semiconductor Industry



Dependable online, inline, and atline solutions for your process needs.

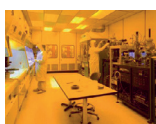
An industry with high standards

Integrated circuits are the fundamental component of modern electronic goods. In our digital era, smaller, faster, and more powerful processors are in constant demand for many goods and services. The semiconductor industry is largely responsible for improving many aspects of modern society as many services have been digitized and interlinked (e.g. Big Data, Internet of Things, and smart grids).

Inside the semiconductor fabrication facility, cleanliness is crucial, considering the scale of the working surfaces (nanometers). Contaminants of all types can result in defects, leading manufacturers to adopt ever stricter production control procedures. A single fabrication plant can use up to 15 million liters of ultrapure water every day. Even bacteria must be removed, as they contain trace

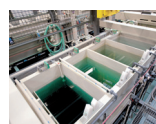
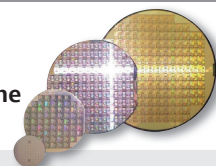
elements which can modify the electrical properties of the silicon wafer used to create transistors for integrated circuits.

There are several steps in processing the raw material (monocrystalline silicon) into a finished integrated circuit. Each stage requires a significant amount of attention to detail to ensure the quality of the finished product is high. Process optimization through online monitoring of parameters such as water quality, acids in etch baths, and metal content in plating baths for example saves time and significantly lowers production costs. Online process analyzers from Metrohm Process Analytics are a must-have in any semiconductor plant to run processes closer to ever-tighter specifications, reducing waste and improving various manufacturing stages.



FEOL Front End Of Line

- SC1 / SC2 clean
- Ultrapure water quality for wafer preparation
- TMAH in developer
- Mixed acid etching bath analysis (MAE)
- Composition of etching cleaner solution
- Hydrogen Peroxide in CMP Slurry
- Sulfuric acid and peroxide mixture in Photoresist Stripping



BEOL Back End Of Line

- Hydrogen Peroxide in CMP Slurry
- TMAH in developer
- Etching baths (mixed acids) composition
- Acid copper bath measurements for Damascene Process
- Heavy metal concentrations in plating baths
- Organic additive concentrations in plating baths
- Electroless Cu/Ni and Hypophosphite [H_2PO_2^-]



SUBFAB

- Ultrapure water quality for Chemical Distribution and Dilution
- H_2O_2 , pH, temperature, and conductivity in Slurry production, blending, and distribution
- ECP Clean (Acid) for Chemical Delivery
- Hydrogen fluoride in Chemical Dilution system
- Ammonium in Chemical Dilution system
- Chloride [Cl^-] in H_2SO_4 recovery system

Overview of a wide variety of applications sold by Metrohm Process Analytics in different areas within semiconductor plants.

Ultrapure water specifications

The most-consumed chemical in the manufacture of integrated circuits is actually ultrapure water. Many plants manufacture ultrapure water on-site as it is needed in several areas, from rinsing after etching steps to the dilution of concentrated chemicals in the subfab. Trace analysis of this ultrapure water can determine if the ion exchangers upstream are working efficiently. Impurities can lead to uneven etching or uneven plating, the results of

which can cost a manufacturer several times more than preventive maintenance to the ion exchanger.

Wastewater from circuit production

Compliance with regulatory agencies is mandatory, and with ever-stricter guidelines coming each year, it is imperative to monitor wastewater and ensure the treatment facility is working effectively. Metrohm Process Analytics offers several process analyzers which can measure from single to multiple components in waste streams, with custom-built sample preconditioning setups and shelters available for more challenging areas around the plant.

Metrohm Process Analytics offers several analytical techniques in many different analyzer configurations for any need: titration, photometry, ion chromatography, NIR spectroscopy, and ion-selective measurements. Our on-line process analyzers and custom sample preconditioning systems are manufactured in the Netherlands and supported by our local service engineers worldwide.

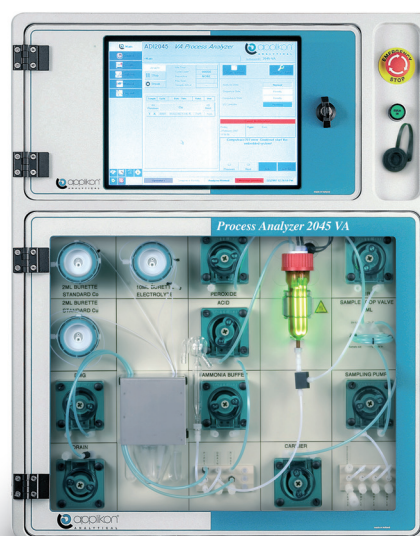
- Concentrated copper waste analysis
- Dilute metal waste stream analysis
- Wastewater monitoring of several components

Applications

Production control of electroplating baths

Cyclic Voltammetric Stripping Analysis (CVS) and Cyclic Pulse Voltammetric Stripping Analysis (CPVS) are widespread methods for the determination of organic additives in electroplating baths. For many technical coatings, particularly in the manufacture of PCBs and semiconductor components, this method is an essential part of production control. Online analysis with the ADI 2045VA Process Analyzer eliminates the need for slow, periodic laboratory QC, guaranteeing continuous and interference-free operation of the plating baths.

- Accurately measure brighteners, levelers, and suppressors
- Precise measurements even in saline conditions
- Concentrations in mL additive per L bath liquid
- Suitable for acidic copper baths, alkaline zinc baths, tin-lead baths, tin baths, and more



ADI 2045VA Process Analyzer

Multicomponent determination in a single run

Ion chromatography (IC) enables the determination of numerous main and secondary components of electroplating baths as well as traces of impurities in the form of organic and inorganic ions or polar substances with utmost reliability and precision. A major benefit is that chemically similar substances can be determined in parallel in a single analysis with IC. Analyte concentrations may extend from the ng/L to % ranges. Interfering matrix effects can be avoided by combining the sample delivery with one of our many automated Inline Sample Preparation Techniques.

- Impurities in electroplating baths
- Concentrated acids in etching solutions
- Nitrate in nickel baths
- Ion analysis in emulsions and soap-containing rinsing solutions
- Trace analysis in ultrapure water



Process Ion Chromatograph

Fast, in-situ, non-destructive analyses

The purity of chemicals, bath composition and other processes can be easily monitored around the clock with on-line near-infrared spectroscopy (NIRS). Chemical-free process analysis with NIRS gives real-time data, saving time and money over other analytical methods. Multiplexer options allow several baths to be monitored by the same analyzer, from opaque slurries to clear liquids. Even the wafer surface can be analyzed with NIR.

- Mixed acid baths
- TMAH in water
- SC1 / SC2
- HF-Dip
- HotPhos (H_3PO_4 in water)



NIRS XDS Process Analyzer

NIRS Analyzer PRO

www.metrohm.com