Semiconductor Application Note
CMP Wastewater Treatment

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Application Overview

Semiconductor fabs use chemical and mechanical planarization (CMP) to smooth wafers by coming in contact with a slurry formulated with hydrogen peroxide, surfactants, and other compounds. Before CMP wastewater can be recycled or disoposed of, dissolved copper must be removed using ion-exchange resins. However, since hydrogen peroxide damages ion-exchange resins, hydrogen peroxide must initially be removed by activated carbon.

First the waste water receives a pH adjustment. Then it comes in contact with catalytic carbon and ion-exchange resins arranged in a lead / lag configuration. This allows complete use of media in the lead tanks with polishing of untreated oxidizer and metal by media in the lag tanks.

The treated waste water receives additional downstream treatment to remove slurry solids (membrane or precipitation). Oxygen gas produced by decomposing hydrogen peroxide is vented or sent to a scrubber system.

Triazoles are used to inhibit copper corrosion. They must be replenished over time because they are not resistant to oxidation.

Typical CMP Waste Water Composition

Component	Concentration
Copper	5 to 100 ppm
Hydrogen Peroxide	50 to 1,000 ppm
Suspended Solids	500 to 5,000 ppm
Organic Chelators	10 to 50 ppm
TOC	10 to 100 ppm
Alkyl/Aryl Triazole	50 to 200 ppm
pH	2 to 6

Wismer, M.; Woodling, R. "Copper CMP Treatment Using the Copper Select™ Process," *Semiconductor Fabtech*, 25th Ed., pp.51-55, (2005)

Operational Challenges

After catalytic carbon treatment, ion-exchange resins are protected up to ~ 20 ppm hydrogen peroxide while still efficiently removing copper. However, standard activated carbon treatment becomes ineffective above ~ 2 ppm because oxygen gas accumulates in the carbon bed disrupting futher treatment. Influent levels of hydrogen peroxide above 1 g/l can destroy the granularity of activated carbon and lead to plugging. Chelating agents, surfactants, and copper can also decrease hydrogen peroxide decomposition performance.

If hydrogen peroxide degrades ion-exchange resins, less waste water will be treated between regeneration cycles. Less copper will be removed and the ion-exchange resins will need to be replaced more frequently. Hydrogen peroxide also adversely affects other downstream process units, such as carbon absorption and membrane filtration.

Oxidation reduction potential (ORP) controlled chemical feed systems lead to over and / or under dosing the reducing agent because the mV response signal changes little over a broad peroxide concentration range.

Waste water should be maintained at pH 3 to 3.5 to ensure copper remains soluble for the ion-exchange resin to pull copper out of the chelate and absorb it on the resin. Since other compounds can change the pH and affect the ionic form of copper, maintaining the buffer capacity is critical.

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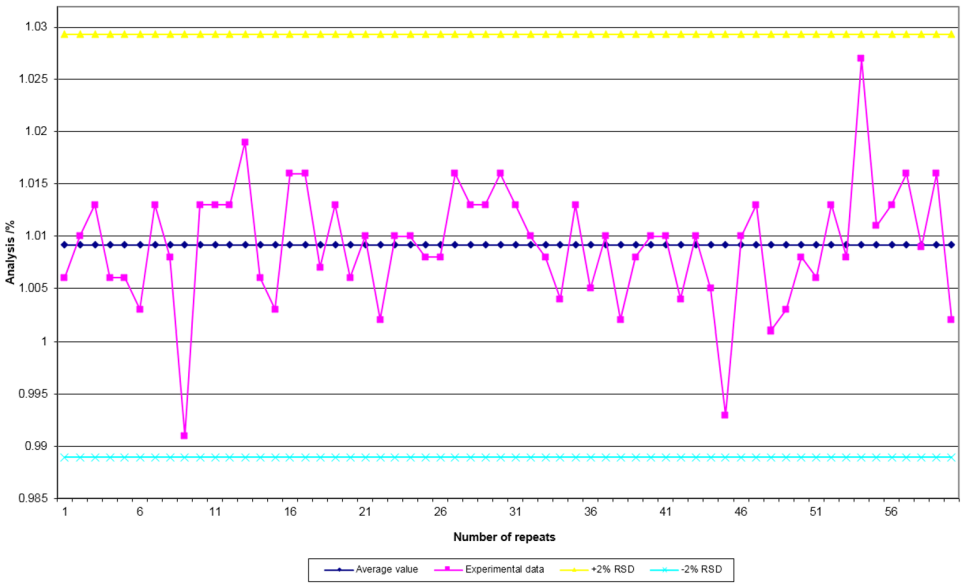
Liquid Monitoring

Hydrogen Peroxide
- More Effective Than ORP Control
- Protect Ion-Exchange Resins
- Protect Other Downstream Units

Copper
- Ensure Successful Removal
- Monitor for Risk of Corrosion

Acidity or Alkalinity
- Maintain Optimal pH for Copper

Performance Guaranteed



Hydrogen Peroxide Analysis With < ± 2% f.s. Repeatability by Potentiometric Redox Titration

Online Benefits
- Identify & Avoid Expensive Process Upsets
- Fewer Personnel for Grab Sample Testing
- Minimize Human Error (Sampling / Testing)
- More Efficient Copper & Peroxide Removal
- Optimize Environmental Compliance

AccuSeries-LPA Advantage
- Certified ATEX / IECEx Zone 2 *Without* a Purge
- Compatible Components Minimize Maintenance
- g/l Calibration Ranges for Thorough Reporting
- ppb Resolution for Accurate Process Control
- Multi-Parameter & Multi-Stream for Fast ROI



AccuSeries-LPA Wet-Chemistry Online Analyzer

Galvanic Difference
- 35+ Years of Experience in Difficult Applications
- Global Sales, Consumables, & Service Support
- Custom Engineering to Customer Requirements
- Methods of Analysis to Match Laboratory SOP
- One-Stop-Shop for Gas & Liquid Online Analyzers

Contact Information

- info@galvanic.com
- +1 (978) 848-2701
- www.galvanic.com