Application Note
Semiconductor Industry

SCHMIDT HAENSCH

Monitoring H_2O_2 Concentration in CMP Slurries

Continuous Inline Control of Hydrogen Peroxide with Refractometry

Chemical Mechanical Planarization (CMP) is a key process in semiconductor manufacturing used to create highly planar wafer surfaces. The process combines mechanical abrasion with controlled chemical reactions to selectively remove material from the wafer. CMP slurries typically contain abrasive particles, water and application-specific chemical components. For many copper and tungsten CMP processes, hydrogen peroxide (H_2O_2) is added as an oxidizing agent.

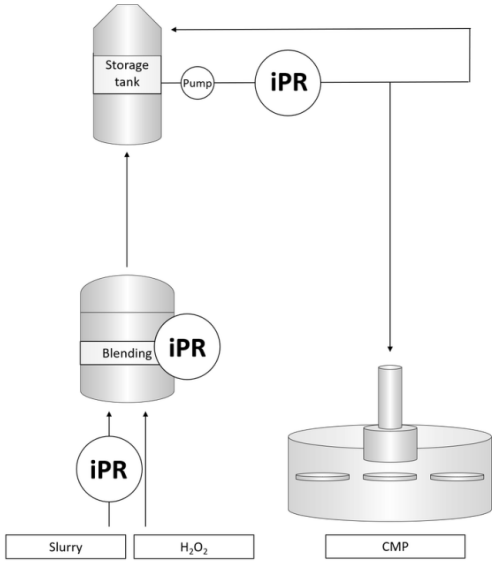
H_2O_2 as a Critical Component in CMP Slurries

Hydrogen peroxide provides the oxidative action required in many CMP formulations. During slurry preparation, concentrated slurry may be diluted with ultrapure water and blended with H_2O_2 before being supplied to the polishing tools. Commercial hydrogen peroxide used for CMP slurry preparation is commonly supplied at concentrations of approximately 35 wt%, whereas the final CMP slurry typically contains H_2O_2 in the range of about 1 to 3 wt%. Precise dilution and dosing are therefore essential to achieve the required peroxide concentration in the final process mixture. Maintaining the specified H_2O_2 concentration is essential because changes in slurry composition can alter the chemical reaction rate and consequently the wafer polishing rate. Accurate blending and concentration control therefore contribute directly to a stable and repeatable CMP process. Inline refractive-index measurements have already been applied to copper, tungsten and interlayer dielectric CMP slurries, both for slurry characterization and for monitoring H_2O_2 concentration. Furthermore, H_2O_2 is not permanently stable in the process mixture. Changes in peroxide concentration during preparation, storage or circulation can therefore shift the slurry away from its specified operating range. Continuous monitoring makes it possible to identify these deviations before the slurry reaches the polishing process.

Refractive Index as Process Analytical Technology

The refractive index (RI) of a liquid changes with its composition. By establishing an application-specific relationship between refractive index, temperature and slurry composition, RI measurement can be used to determine changes in H_2O_2 concentration directly in the process stream. An inline process refractometer continuously measures the optical properties of the slurry without requiring discrete samples. The optical measurement is based on total internal reflection.

For CMP applications, this approach provides an important advantage over discontinuous laboratory measurements or online titration. The process can be observed continuously, enabling rapid detection of incorrect dilution, peroxide dosing errors or composition drift. In a typical slurry delivery system, raw slurry, ultrapure water and hydrogen peroxide are combined at a blending station before the finished mixture is supplied to a day tank or directly toward the CMP tools. An inline refractometer can be integrated into the recirculation or distribution line to continuously verify the resulting composition. The measurement signal can be transferred directly to the process control system. This allows the actual H_2O_2 concentration to be compared with the specified target and enables corrective action when the concentration moves outside defined control limits.



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Solution from SCHMIDT + HAENSCH

Using the **SCHMIDT + HAENSCH iPR S Inline Process Refractometer** for semiconductor industry represents a state-of-the-art solution for continuous H_2O_2 concentration monitoring in CMP slurry preparation and delivery systems. The refractometer is designed for demanding semiconductor applications and enables direct measurement of the process medium without the need for manual sampling. All wetted parts are made of high-purity, chemically inert plastics, ensuring excellent chemical compatibility and minimizing the risk of contamination in sensitive semiconductor processes. By integrating the iPR S into the slurry blending, recirculation, or distribution line, manufacturers gain immediate insight into the H_2O_2 concentration and overall slurry composition. This enables rapid detection of incorrect peroxide dosing, dilution errors, or concentration drift. The measurement signal can be integrated directly into the process control system, allowing deviations from the specified H_2O_2 target concentration to be detected and corrective actions initiated before the slurry reaches the CMP tool. This supports consistent slurry composition, stable polishing conditions, and reliable semiconductor manufacturing processes.



Product type	Product
Process Refractometer	**iPR S** Inline Process Refractometer

Advantages

- Continuous, real-time H_2O_2 concentration monitoring
- Direct inline measurement without manual sampling
- Fast detection of incorrect peroxide addition and concentration drift
- Supports precise CMP slurry blending and dilution control
- Suitable for copper, tungsten and ILD CMP slurry applications
- Immediate measurement signal for process and fault control
- Reduced dependence on discontinuous laboratory analysis
- Supports consistent slurry composition and reproducible CMP processing

Typical industries

- Semiconductor fabrication
- CMP slurry blending and distribution systems
- H_2O_2 blending and dosing

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