ABSTRACT

Adaptive Point-of-Use Chemical-Dosing Cartridge for Semiconductor Wet-Processing

The invention comprises (i) a sealed fluoropolymer cartridge that stores a single, high-purity process concentrate; (ii) an embedded multi-parameter sensor manifold capable of measuring ionic contamination (<0.01 ppb), nano-particle concentration (≥ 5 nm), pH, conductivity and temperature in real time; (iii) a fast-response piezoelectric isolation valve that meters millilitre-scale pulses of concentrate directly into a continuous base stream; and (iv) a micro-controller executing sub-second control logic that adjusts valve duty in response to the sensor vector. The cartridge docks to a lithography track or other wet tool through a keyed, self-sealing quick-connect that enables liner replacement in under five minutes without line purge. Closed-loop operation maintains wafer-side chemistry within ± 0.5 % of target while reducing chemical consumption by 30–40 %, halving concentration-driven defects, and generating a SEMI E143-compliant, per-dispense digital batch record. The architecture further includes hierarchy-based interrupt handling to prioritise wafer-critical corrections across multiple simultaneous cartridge lines.

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