## Wafer Backsides: The Key to Future Technologies

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Until recently, contamination control efforts have almost exclusively focused on the frontsides of wafers. After all, that is where the critical films are placed and what most processes seek to affect. What current technologies and contamination control efforts do not account for is that backside contamination is just as critical to semiconductor manufacturing processes, especially as the industry moves to 300 mm and 0.18 micron and below technologies. This is most visibly demonstrated in photolithography application where backside particle contamination leads to hot spots, which create focal plane deviation. Hot spot removal decreases stress on the wafer, in turn flattening the wafer and improving depth of focus. The end result is an increase in yield and fab productivity.

Backside contamination control is becoming critical to the advancement of semiconductor fabrication. In current fabs, wafer backsides are exposed to all types of contamination sources. The backside of a wafer is the most susceptible to, and a focal point for, contamination. Currently, there is no way to measure backside contamination levels. Metrology tools have failed to live up to their expectations in contamination inspection of the backside. Because metrology tools require smooth silicon substrate surfaces to accurately measure contamination, they cannot be applied to the backsides of wafers.

Nearly every process in a fab causes backside wafer contamination. All handling systems as well as cassettes and lot boxes deposit some kind of contamination on the backside of a wafer. Cross-contamination, which occurs as the wafers pass through the different process equipment, is another major area of backside contamination. Dry etchers, electrostatic chucks, chemical mechanical planarization (CMP) and deposition tools can all lead to backside contamination. While cleaning operations are inherent in many of these processes they rarely can affect particles that have already been embedded in films. New materials that are being incorporated into the semiconductor fabrication processes, especially copper, raise

new contamination concerns. If these materials become contaminants, they are at risk of affecting all of the other equipment in a fab.

The problem is that most current cleaning technologies (scrubbers, wet bench, spray systems) simply cannot be applied to the backside of the wafer without damaging the critical frontside film. With traditional cleaning methods, too many treatments must be applied to the wafer frontside to make backside cleaning possible without raising operating costs to unacceptable levels. There is only one system currently available that can effectively clean the backside and flatten the wafer without damaging the frontside: spin-processing.

Until recently the industry has been able to ignore the backside of wafers. The advent of smaller geometries, larger wafer diameters and advanced lithography techniques make this impossible. SEZ has developed the proprietary spin processor to address backside contamination issues. The process removes unwanted films and embedded particle contamination accumulated during processing. Removing hot spots from the wafer backside relieves stress on the wafer, allowing it to flatten out and eliminating depth of focus problems. SEZ's spin processor does not require any protection for the device side of the wafer because the wafer hovers on a nitrogen cushion above the chuck surface, preventing damage to the opposite side of the wafer. This technology achieves high selectivity, excellent uniformity, unmatched process repeatability, and low particle defect density because of low particle counts and watermark prevention. Finally, spin processing is adaptable to customer needs and can remove several layers in one single process cycle, significantly impacting overall production yield.

During testing of the spin processor, the average success rate of prior stepper rejects after backside removal using the spin processing system was above 90 percent. The process also creates no cross contamination or redeposition of particles or metallics, and the spin etch cleans the bevel of the wafer. Demonstrated particle contamination reduction by the SEZ spin processor is greater than in any wet bench or spray batch system, achieving a removal efficiency that is 10 – 20 times higher.

The ability of any given tool to adapt to multiple processes will be key to future contamination control technology. Spin processing technology already meets this requirement and can be used on wafer frontside and/or backside at various stages of wafer production. The spin processor developed for use in lithography applications can handle up to three different chemicals in programmable sequences to process wafers in a single process cycle with an additional DI water rinse and a nitrogen dry. The control system is completely flexible, permitting selection of any combination of three etching chemicals, nitrogen and DI water. The process chemistries used are film-dependent, and all chemicals can be recycled or drained within the system. A combination of four chambers next to each other can yield a throughput of up to 200 wafers per hour of 200 mm or 300 mm in diameter. Short process time, precise control of chemical application, minimal use of DI water and excellent cleaning results translate into improved performance and reduced cost.

For now, photolithography is driving backside contamination control and hot spot issues. It will soon be joined, however, by the major 300 mm players looking for a process to relieve the stress on wafers after backgrind. As technology moves into low-k dielectrics and copper interconnects, total contamination control will be critical to achieving desirable production yields. Finally, 0.13 and 0.18-micron technologies will focus the industry on the importance of backside contamination control because these geometries cannot be achieved if wafer backsides are contaminated. While spin-processing technology will not replace current cleaning methods, 300 mm, advanced low-k and new chemistries requiring minimal exposure times will drive the industry away from using frontside-only treatments. Spin process technology has already addressed backside contamination control issues and is now waiting for the industry to catch up.