NEW PRODUCT ANALYZES WAFER CONTAMINATION IN REAL TIME

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A clean, contamination-free process environment is critical for maximum yield in all stages of semiconductor fabrication, assembly and test.

Handheld and benchtop particle counters, commonly used to track particles in semiconductor tools are relatively low cost and simple to use.

These counters, however, can only monitor the easily accessible areas of open tools.

The same sensor used for equipment particle qualification and preventive maintenance during wafer front-end processing has the potential to replace or reduce the use of costly defect inspection tools.

Eliminates Costly Traditional Methods

As is the case with front-end processing, the ultimate goal of APS is to reduce and/or eliminate the need for the more costly and time-consuming traditional methods such

A new airborne particle sensor (APS)

APS is currently being tested for possible use in post-fab applications during wafer testing, CMOS sensors and wafer bumping.

Wafer Bumping and Testing

During wafer testing, operators want to check the cleanliness of the probe. For CMOS sensor customers, the smallest particle size requested is from 0.5 or 1 µm, which is half the pixel size of a CMOS sensor.

For wafer bumping (bump height 50µm – 100µm) or wafer-level CSP (bump height 200-400µm), the process for airborne particle detection is similar to front-end wafer processing but the critical dimension of particle detection is not as small (5 and 10um).

The trend is to shrink the bump height (think thinner and thinner, for example the *iPhone*) to 10 µm, some processes may be interested in even smaller defect size to 3 µm or even 1µm.

For backend processes, an APS calibrated to detect larger particle sizes of 0.3µm and 1.0µm is available.

Offered in 200mm and 300mm form factors, APS can go deep inside a tool and communicate data unlike legacy handheld particle counters whose range is limited by hand reach and require opening the tool.

Identifies Particle Counts at Each Station

By identifying particle counts at each station and along connecting paths, the APS helps equipment engineers quickly locate when and where the source of particles originate as well as what was happening at the time.

Capable of detecting and counting particles as small as 100 nm, (0.1 micron), the sensor reports data wirelessly in real-time to a PC where it is graphically and numerically analyzed using APS companion software.

While APS might not be a direct replacement for monitor wafers in all cases, the APS can be used

NEW PRODUCT: APS

such as coater/developer tracks, thermal diffusion, deposition, etch equipment and material handling systems, to speed their release to production.

For example, with special maintenance receipts, the APS can verify 50-track tool chambers in a matter of minutes.

Programmed Maintenance Receipts

These maintenance receipts can be programmed to actuate moving parts to check for components in need of maintenance or replacement.

Using monitor wafers to accomplish this same track-tool particle qualification could take up to two days.

The APS also troubleshoots problems should tools fail qualification—quickly identifying where particles originate in lieu of a monitor wafer that could take hours to determine where a particle event is occurring.

For example, with the APS a PVD tool owner with a tool-defect problem can identify specific chamber shedding particles in a matter of minutes, allowing engineers to take immediate corrective action.

Verifying Resolution

The APS can, then, quickly verify resolution of the chamber particle problem.

A traditional handheld or benchtop counter would not work as effectively in this scenario because chambers would have to be opened.

Likewise, using traditional monitor wafers would take significantly more time when factoring chamber segregation and wafer analysis times.

How It Works

As airborne metrology, the Airborne Particle Sensor requires some partial pressure of inert gas.

Hence, it cannot perform in vacuum conditions. In operation, the APS uses a fan to pull non-corrosive gas or air through an internal chamber past a laser and detector.

Using light scattering techniques, the APS detects particles in the gas or airstream.

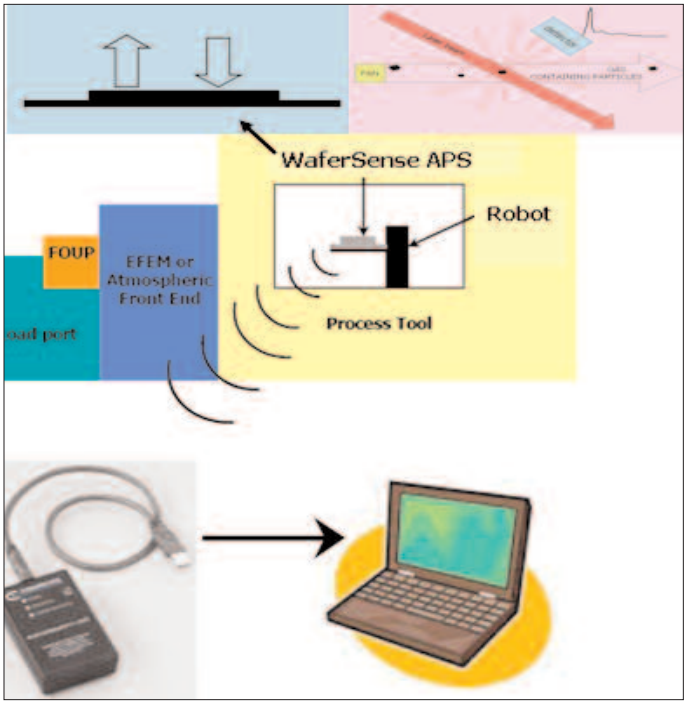
As the laser light strikes particles, some light is scattered into the detector, which counts the particle signals and sorts them into two particle size channels.

Communicates Particle Data Wirelessly

Through Bluetooth (Windows USB) technology the APS communicates particle data wirelessly to a dedicated Link Box that interfaces with the sensor's companion application software that runs on a laptop or system console.

Here, the particle size and count information is processed, displayed and stored. With this information, engineers can efficiently classify particles and their exact sources.

The application software provides real-time numeric and visual feedback, offering actual counts per minute of particle density or particle frequency in addition to differential and cumulative counts.



The APS communicates wirelessly with a link box that interfaces with companion APS software downloaded on a laptop.

With real-time views of particle conditions, engineers can address specific trouble spots—rather than guess and check throughout the whole tool—and be better prepared to pass particle qualifications on the very first attempt.

Engineers can also annotate comments (see graphs) while reviewing data in realtime, indicating when and where spikes in particle counts occur in specific chamber locations.

Compare Particle Counts

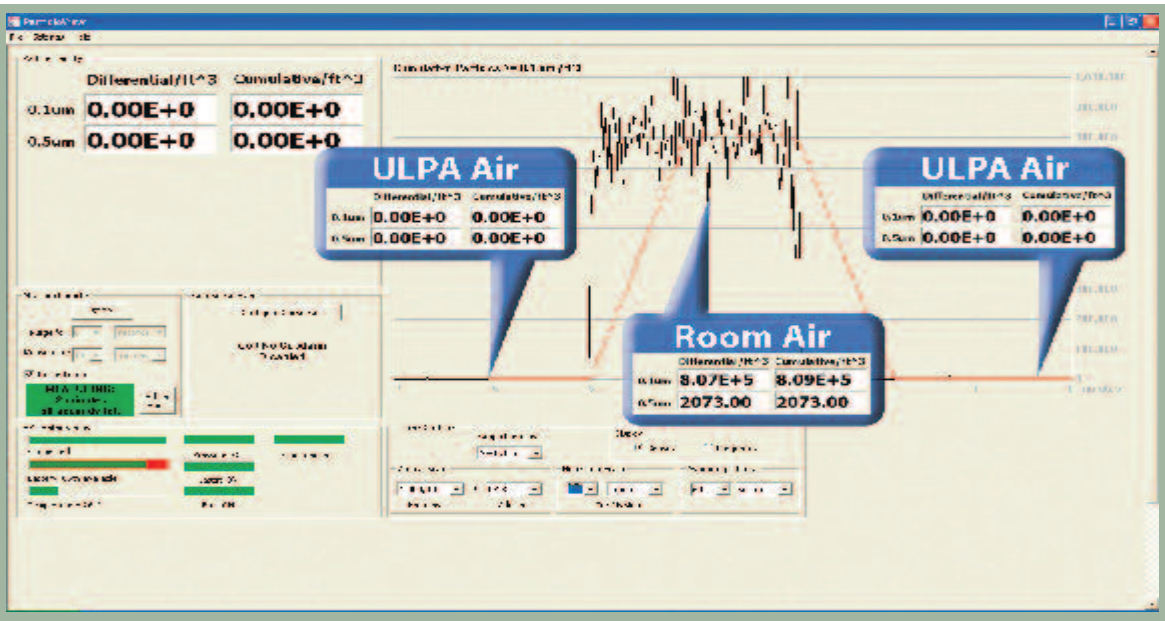
Later, operators can go back to this data and compare particle counts to actual locations in the tool.

The software replays log file data for review and analysis so engineers can compare past to present operations as well as one tool to another to conduct machine-to-machine trend analysis of particle conditions and to establish process control and conduct process improvements.

Establish a Baseline

In essence, the APS system can be used to establish a baseline and ensure operations continue on this baseline as part of preventive maintenance.

Whether used for equipment particle qualification or preventive maintenance during wafer front-end processing, the APS can help improve die yield, compress final wafer inspection and lower operational costs by reducing process equipment downtime and lowering monitor wafer consumption.



Above, ParticleView displays and trends particle levels and trends particle levels. Here the APS is first placed in an ultra clean ULPA tower and reads zero particles. Below, Annotation: Chamber B door of a PRT tool is actuated several times to test for particle shedding.