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FEATURE ARTICLE

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Reports from the Fab

Increasing Uptime of Endura/Centura Tool Sets and Film-Deposition Uniformity

The User

A thin-film group at a 300mm European fab.

Legacy Robot Teaching Hits Snags

The thin-film group at a European fab needed to reduce the tool and production downtime borne from a time-consuming metrology process that required multiple technicians to vent and dismantle Endura/Centura tool sets and employ manual methods to teach wafer-transfer coordinates to robots. The process took approximately 24 hours.

The legacy robot-teaching method required techs to follow a manual process to set up, maintain and troubleshoot the Endura and Centura tools. The labor-intensive process produced inaccurate measurements in micrometers, misalignments and wafer mishandling in the tools.

The process ultimately reduced the group's film-deposition uniformity and die yield per wafer due to particle generation, producing wafer scrap, according to Allyn Jackson, customer support manager at CyberOptics Semiconductor.

"The manual teaching process was basically inefficient and had become a significant drag on the productivity of staff, tools and the entire group," Jackson said. "They were looking to address and correct what was, for them, clearly a flawed process."

Techs in the thin-film group used legacy teaching methods that employed bubble-levels, calipers and dowel pins to manually set robots' wafer-transfer coordinates. The manual methods required the group's manager to dedicate multiple technicians to cool, vent and dismantle tools. Many of the procedures relied on line-of-sight, eyeballing and technician consensus to calibrate robots.

The techs' ongoing work with the off-line Endura and Centura tools increased the risk of particle generation and contamination and made inline and impromptu handoff checks impossible, increasing maintenance overhead.

The legacy process put techs in danger when it required them to reach hard-to-access tools or set blind handoffs – or assign calibration data found in an open chamber to closed chambers.

Jackson added that the techs primarily set wafer-transfer coordinates in the Endura and Centura tools by aligning dowel pins through the end-effector, chuck and custom Plexiglas fixture holes.

"The techs, of course, made the most of the process and would get in there as a team to see it through and come away with something," Jackson said. "It was just a great deal of work and downtime to get imprecise data."

Each technician followed the group's manual teaching process differently, depending on their training, skill and overall experience. The highly variable calibration methods prevented the thin-film group from establishing a repeatable teaching process for the Endura and Centura tool sets.

"And none of their calibrations were performed under vacuum, so the measurements they managed to collect didn't reflect true production conditions," Jackson said.

Jackson said that the legacy robot-teaching process left the thin-film group without reliable or complete metrology data to establish uniform teaching standards for the Endura and Centura tool sets across the fab.

"They didn't have the sort of reliable and repeatable data they could turn around and use in any meaningful way to improve their maintenance and production processes or establish standards," Jackson said.

Once the techs completed their manual teaching process, the thin-film group continued to remain off-line to reassemble the Endura and Centura tool sets and restore both vacuum and production processes, which, in many cases, took four to eight hours.

Looking at Automated Robot Teaching

The European fab's thin-film manager recognized that his group's legacy robot-teaching process was flawed and represented a cost-savings opportunity. He set out to find an automated method that would allow techs to quickly teach wafer-transfer robots in the Endura and Centura tool sets and ensure repeatability.

The manager corresponded with CyberOptics' Jackson and invited him to demonstrate the company's wireless robot-teaching device with an on-board camera. Jackson performed on-tool testing of the automated, wafer-like device and left it with the manager to implement a short evaluation period.

During the evaluation, the manager placed the wireless device in one of the tools to obtain real-time wafer-transfer coordinates via the device's companion software and set handoff positions. He asked a team of techs to simultaneously calibrate a second tool using the group's legacy robot-teaching process.

The manager loaded the wireless device on the end-effector blade's centering hole. The tool transferred the device as if it were a wafer to all process locations for efficient handoff teaching and quality checks.

"I worked side-by-side with other engineering staff in troubleshooting and adjusting the wafer handoffs on two adjacent tools," reported the thin-film group's manager. "I completed the tool (10 chambers checked and two adjusted) in two hours with the ATS (Auto Teaching System). My colleagues took 6 hours on their tool to look at two chambers using the traditional method, and they still had issues beyond that, which meant 2 days to get the tool back on-line."

The WaferSense® ATS device obtains live video from inside the tool and reports in real-time the ATS' three-axis (X, Y, Z) coordinates in relation to a target via the GUI of its companion software. The device reports X and Y axis offsets with an accuracy to 100um, which allowed the group to obtain precise wafer-transfer data -- including go, no-go data -- to analyze, improve and set process standards.

With the device, a single tech was able to set up, maintain and troubleshoot the Endura and Centura tools while reducing typical maintenance time from 24 hours to 3-4 hours. The process did not require the tech to cool, vent or dismantle the tool. The wireless device works in environments up to 120 °C for up to five minutes, is vacuum compatible and automatically moves -- like a wafer -- through the entire tool set.

Jackson added that the device's wireless transmission of data from inside the tool eliminated the need for dangerous blind robot teaching by techs.

“They had to worry about so much less at that point and could really start to focus on other maintenance-related issues and optimizing their tools,” Jackson said. “They completely re-invented their process.”

Jackson guided the thin-film group throughout its transition to automated robot teaching. He offered support during the group’s internal evaluation, as well as training on the device and ongoing technical support.

“Once you load the device, you’re dealing with an automated process and straightforward interface, which really make for smooth implementations and training,” Jackson said.

The thin-film group’s manager later contacted his counterparts in the European fab and encouraged them to discuss wireless wafer-processing metrology with Jackson.

The Bottom Line

The European fab’s thin-film group used the automated wafer-like device to replace legacy robot-teaching methods for the Endura and Centura tool sets and save hundreds of thousands of dollars per year by adopting WaferSense ATS for wafer-handoff teaching.

The savings came largely from the thin-film group’s ability to use the device to reduce -- per tool -- robot-teaching downtime by 20 hours. The device allowed the group to reduce the number of techs required for robot teaching from three to one and save approximately 3,500 staff hours per year, while increasing per-wafer die yield.

“When they looked at the whole process and the efficiencies they’d gained, the empirical data was quite dramatic and more than justified the comparatively nominal investment for them,” Jackson said. “The typical ATS ROI is in the first 1 to 3 uses.”

Techs used the precise wafer-transfer coordinates they obtained with the device to set accurate tool alignments and improve overall wafer handling, including on-demand handoff checks. The Endura and Centura tool sets remained under vacuum during teaching and didn’t require the group to set blind handoffs -- or assign calibration data found in an open chamber to closed chambers.

The new automated robot-teaching process helped the thin-film group increase film-deposition uniformity and die yield per wafer by reducing particle generation and wafer scrap.

Real-time data obtained by the wireless device allowed the thin-film group to establish a repeatable robot-teaching process for the Endura and Centura tool sets and uniform process controls, eliminating tech-to-tech variances and a metrology process founded on manual trial-and-error.

All techs were able to automatically set up, maintain and troubleshoot handoff positions for wafer-transfer robots, regardless of their fab experience.

The group manager’s use of the wireless ATS device ultimately moved him to order the company’s Auto Leveling System (ALS) and Auto Vibration System (AVS) to further optimize the fab’s thin-film process, uptime and tool productivity.

As a pre-emptive measure, the manager also ordered spares of the ATS to ensure the thin-film group wouldn’t be without the device for any reason down the road.

“The savings across the board for his group was such that it just made sense for him to get more devices upfront than be without the device for any period of time later,” Jackson said.

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