Ultrafast Laser-Based Sample Preparation for Optimized FIB/SEM Workflows in High-Throughput Analysis

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With the increasing complexity of semiconductor devices, efficient and precise sample preparation has become essential for failure analysis, quality control, and advanced research and development. The microPREP® systems integrate ultrafast laser technology into the FIB/SEM workflow, enabling high-speed, athermal material ablation with micrometer-level accuracy. This approach significantly reduces preparation time from hours to minutes.

By employing ultrashort-pulse lasers, the system enables large-volume material removal with minimal thermal effects.[1] This capability is particularly beneficial for applications such as FIB trenching[2], atom probe tomography (APT) microtip fabrication[3], and cross-sectioning of advanced semiconductor packages[2]. Integration with xenon (Xe) plasma FIB-SEM systems establishes a hybrid workflow in which laser ablation performs bulk material removal, followed by high-precision FIB polishing for final refinement, thereby optimizing throughput.[1, 2, 3, 4]

This laser-based methodology is particularly impactful in semiconductor manufacturing, where speed, repeatability, and accuracy are critical. Computer-aided design (CAD)-based targeting further enhances precision by enabling rapid access to specific regions of interest. Case studies, such as flip-chip package analysis[2] and atom probe tomography, demonstrate significant improvements in productivity and process control.

This study demonstrates that integrating femtosecond laser systems into semiconductor workflows transforms sample preparation and offers a scalable solution to meet the requirements of next-generation device analysis.

References

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