POSTER #

SWTest Asia Conference

Innovative Test Strategies for Silicon Photonic Devices in Engineering and Production Applications

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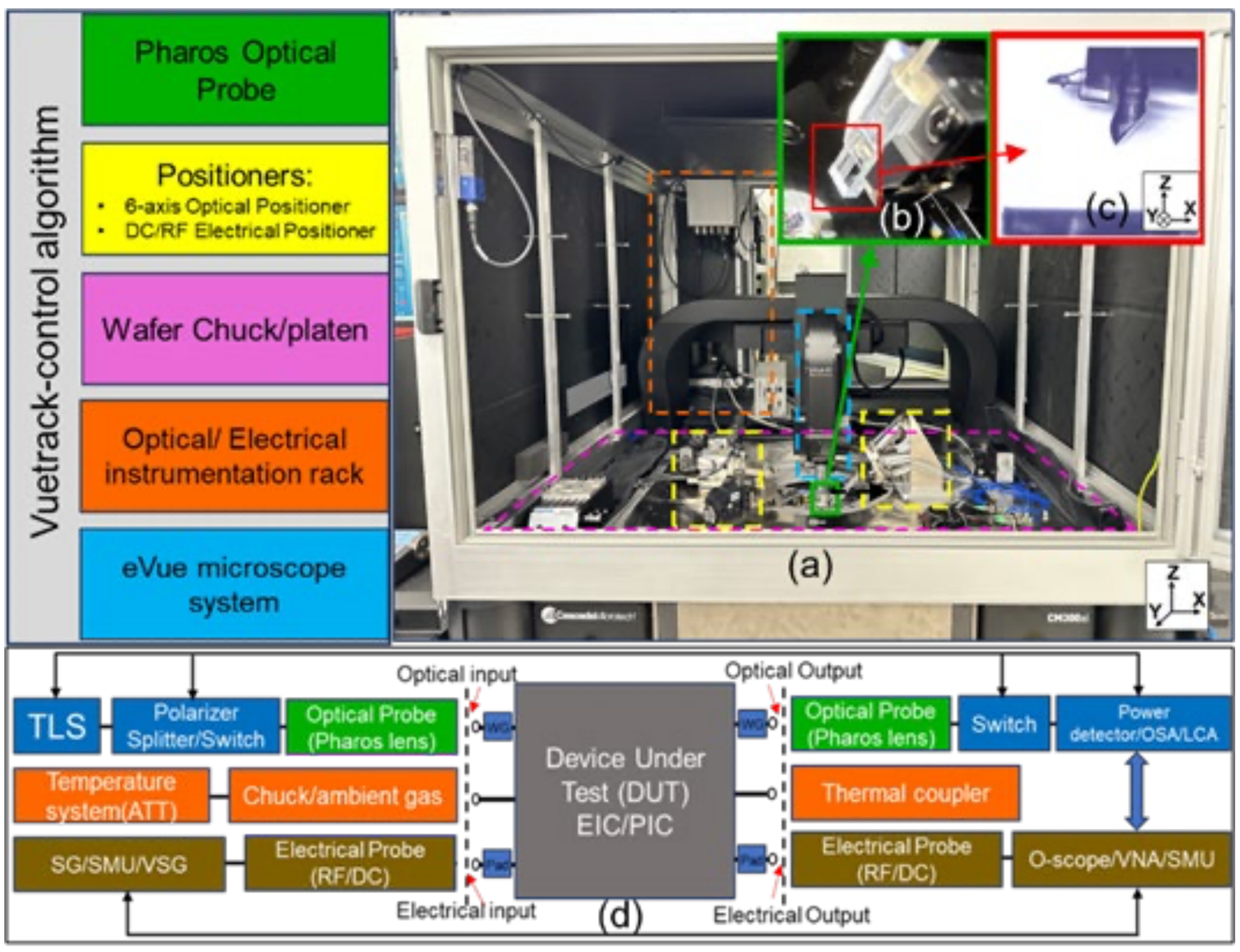
Introduction

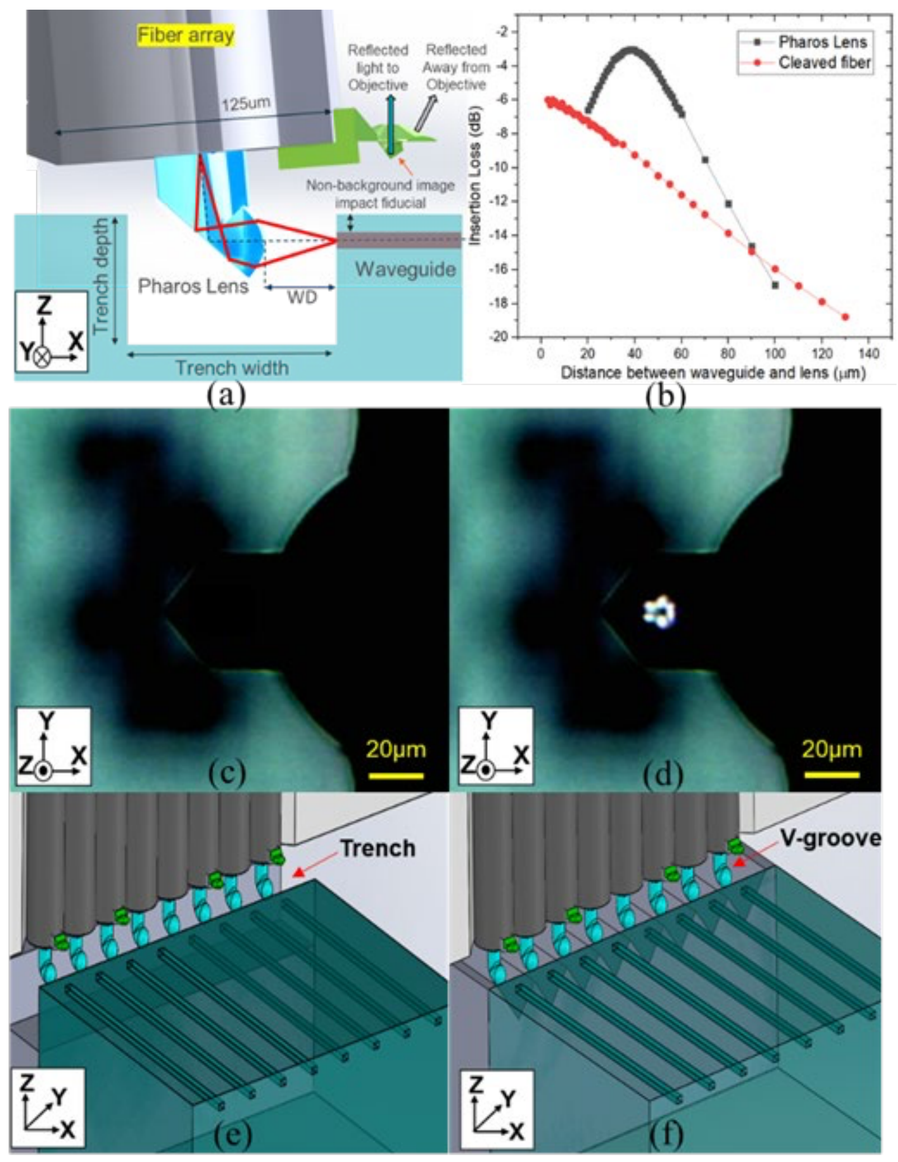
PIC testing in photonic foundries demands:

- high coupling efficiency
- rapid throughput
- wafer-level accessibility
- the assurance of measurement repeatability and stability.

FormFactor's solution demonstrates fully-automated edge coupling at wafer level. We focus on all aspects relevant to a complete test solution and provide a comprehensive overview of all factors.

We first focus on the optical probe, FormFactor Pharos lens technology, which features a periscope structure designed to effectively convert incident light from a vertical orientation to a horizontal one. With the MFD aligned and the correct incident angle, we have been able to reduce coupling losses to an 0.52 dB/facet. Beside the periscope structure, the Pharos lens technology also features a distinctive fiducial which is designed to consistently yield high-contrast images, enabling machine vision algorithms to accurately pinpoint the optical probe's location in free space





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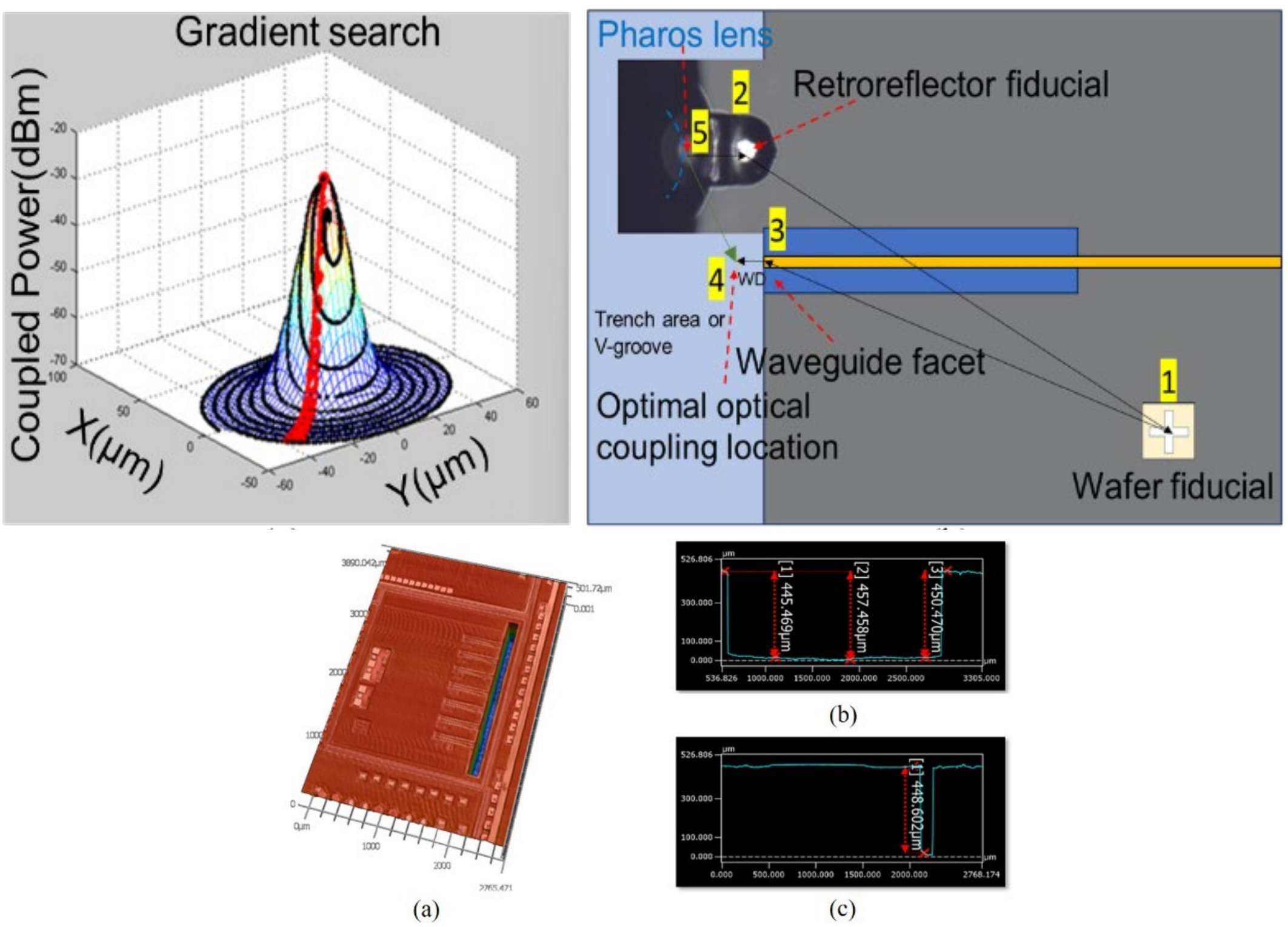
Materials & Methods

We developed the FormFactor Pharos lens using advanced two-photon lithography, achieving nanometer-scale precision for complex 3D micro-optical structures.

By integrating multiple technologies, our system enables fully automated, wafer-scale edge coupling with outstanding efficiency, speed, and measurement stability. This comprehensive solution streamlines optical testing and sets a new standard for reliability and throughput in photonic device evaluation.



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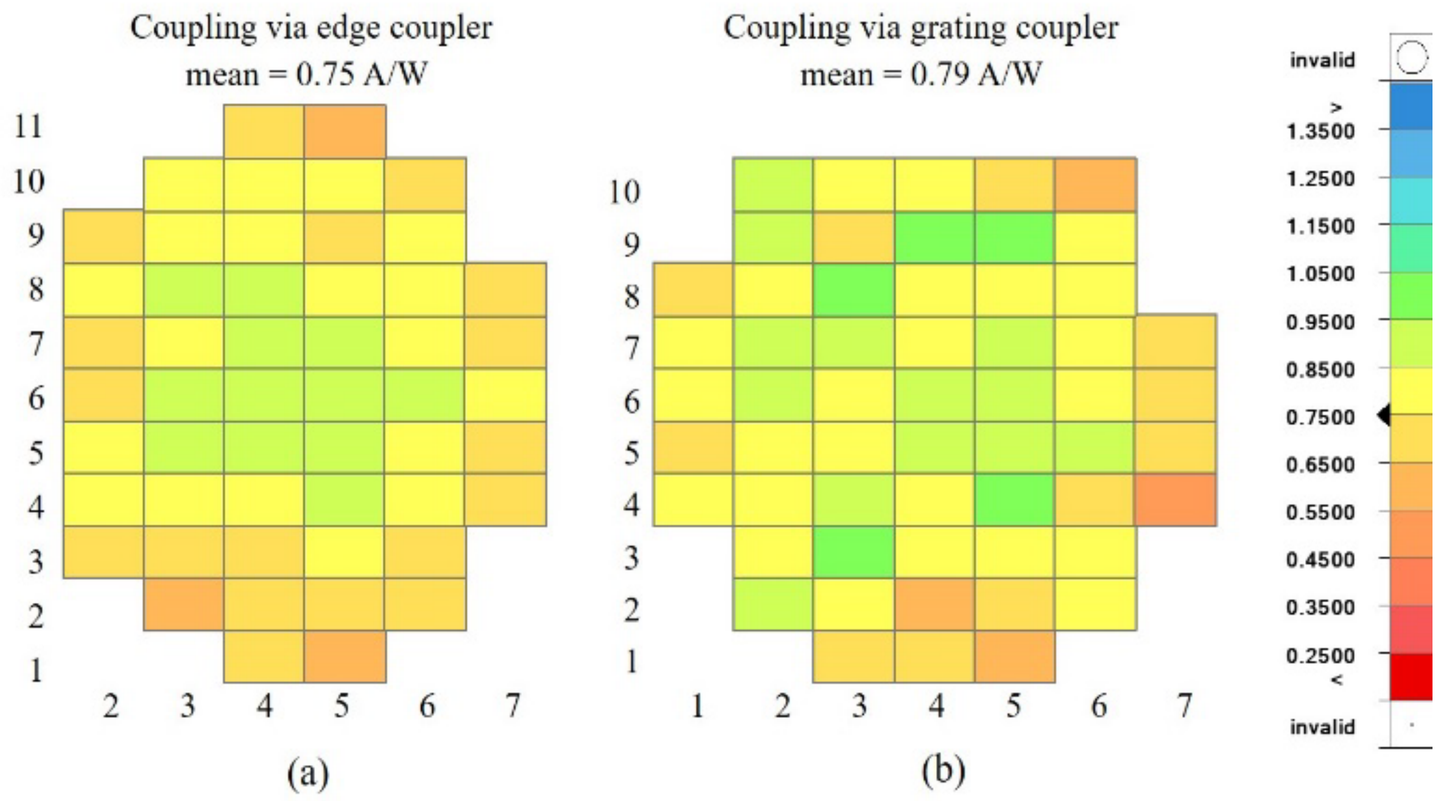
Conclusion

We presented a novel, fully automated wafer-level measurement system for edge coupling in silicon photonic integrated circuits. The system showcases an industry-ready solution for automated probing and measurement of photonic devices at both the wafer and production levels. By integrating precise optical probing technology, advanced alignment algorithms, and robust calibration methods, the system effectively addresses key challenges in photonic integrated circuit (PIC) testing. The incorporation of Pharos lens technology, featuring a periscope-like structure, ensures reliable, high-efficiency optical coupling, while adaptive optics algorithms enhance accuracy.

Experimental evaluations conducted on 200 mm silicon wafers demonstrated the system's high repeatability and stability, validating its effectiveness as a tool for automated edge coupling testing. The results emphasize the critical role of comprehensive calibration and innovative optical probing technologies in achieving consistent and accurate measurements. Overall, the system's performance reinforces its potential to set new benchmarks in wafer-level silicon photonics testing, supporting more reliable and efficient manufacturing processes for the photonics industry.



The wafer level distribution of the internal photodiode responsivity obtained with (a) edge coupling and (b) with grating coupling.