

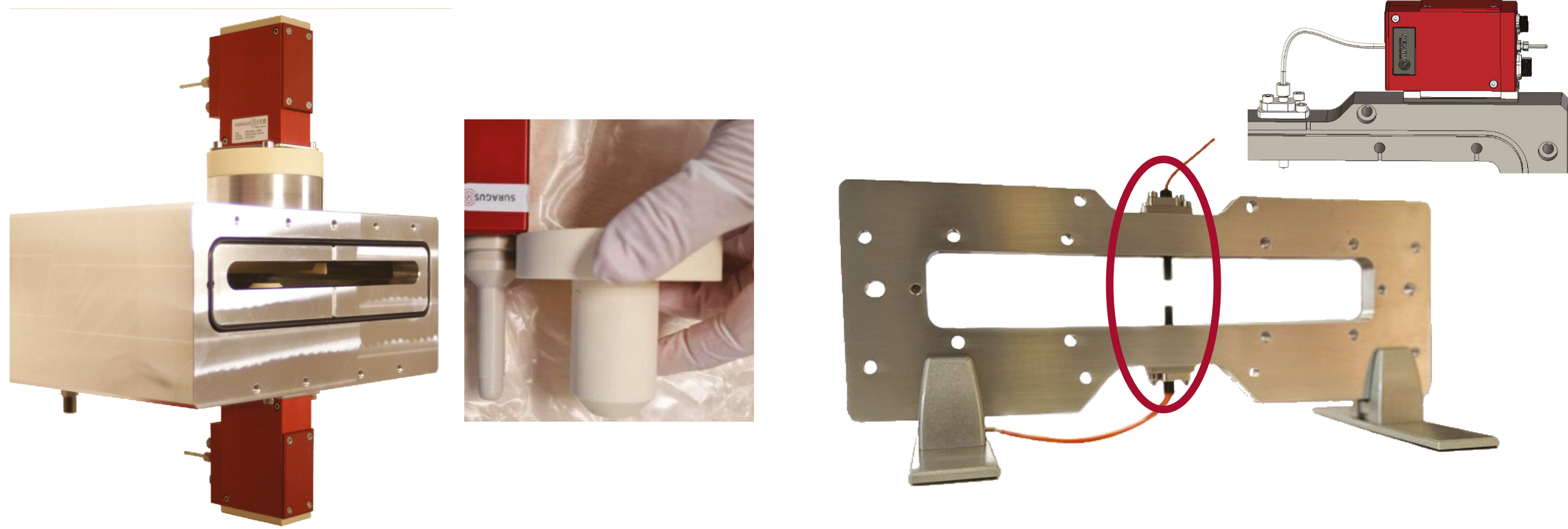
Novel Metal Characterization Approaches by Inductive Testing

Near Process Sensor Integration For Continuous Inline Quality Control

Current Practice and Objective

Current offline methods fall short due to time delays, low sampling frequency, limited spatial resolution, and the lack of integrated sensor systems in vacuum environments. This limited, delayed feedback means that process deviations are often detected too late, after many wafers have already been affected.

The optimum scenario would provide continuous, contactless, and non-destructive measurements directly inside the deposition chamber, covering every wafer and multiple locations. This would enable immediate feedback, automated process control, and eliminate delays.



High-resolution, High-speed Imaging For Metallized Production Wafer Monitoring

Current Practice and Objective

Currently, random sample measurements are performed offline on metrology tools outside the deposition cluster. Only one or two wafers per lot are measured using four-point probe, eddy current, or optical systems. Most wafers remain unchecked, deviations are often detected too late, and limited spatial resolution may miss local non-uniformities.

A high throughput imaging scenario would provide real-time, production wafer-level, full-coverage measurements —enabling immediate corrective action, and earlier detection of drifts.



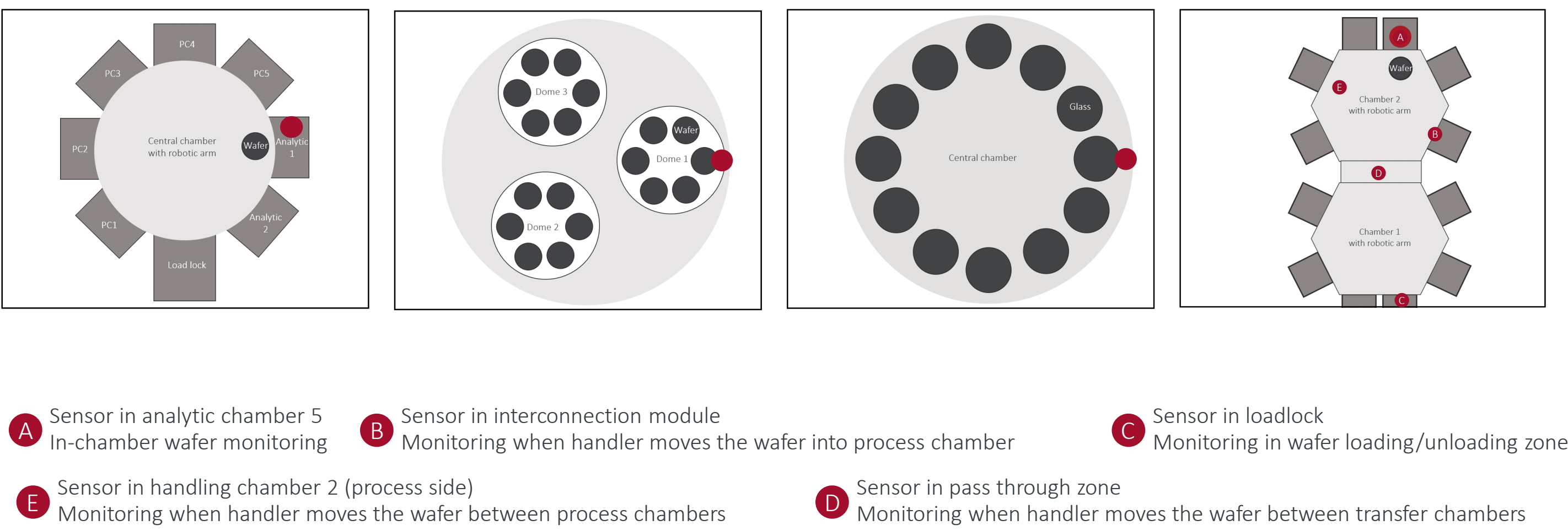
Motivation for In-vacuo Process Sensor Integration

- ▶ Instantaneous measurement on actual process wafers
 - ▶ Eliminate time-consuming, quality-impairing contact-based measurement
 - ▶ High-speed measurements with no contact to layers
 - ▶ Sheet resistance and metal layer thickness
- ▶ Increase system up-time
 - ▶ Higher throughput and wafer yield
 - ▶ Reduce efforts regarding test wafer infrastructure
 - ▶ Reduce coating cost per wafer
- ▶ In-chamber testing
 - ▶ Quick decisions on process optimization
 - ▶ Improve process parameters live
 - ▶ Better device performance and improved yield

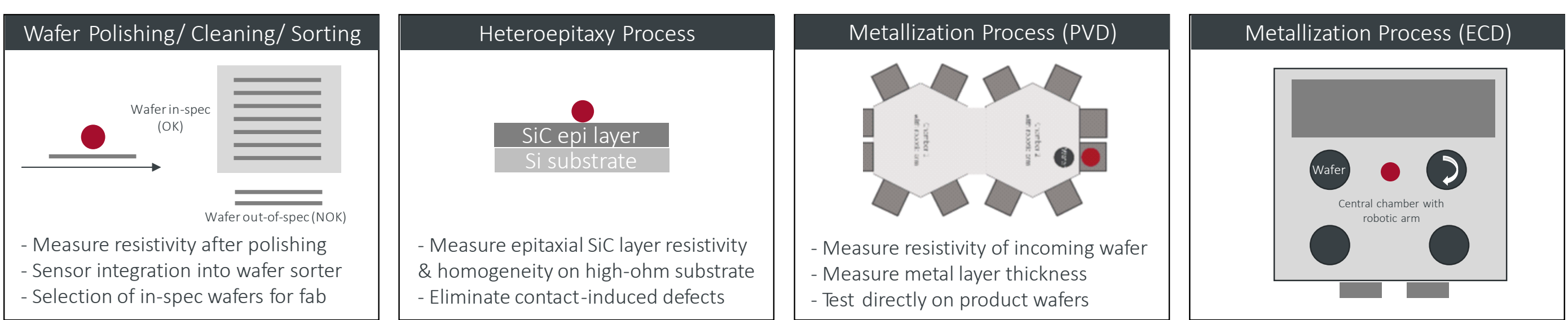
Motivation for Wafer Metallization Imaging

- ▶ Non-contact eddy current measurement
 - ▶ Enables tests on production wafers
 - ▶ Measurement of conductive layers underneath insulating layers
 - ▶ Information about metal layer uniformity and wafer dimensions
- ▶ High-resolution imaging
 - ▶ Up to 60 000 real measurement points
 - ▶ Measurement close to the edge
 - ▶ Identify small defects
- ▶ High-speed imaging
 - ▶ 60 wafer per hour with 20 000 real measurement point
 - ▶ Quality monitoring of all production wafers
 - ▶ Combined data acquisition of sheet resistance, wafer thickness, TTV, warpage and bow

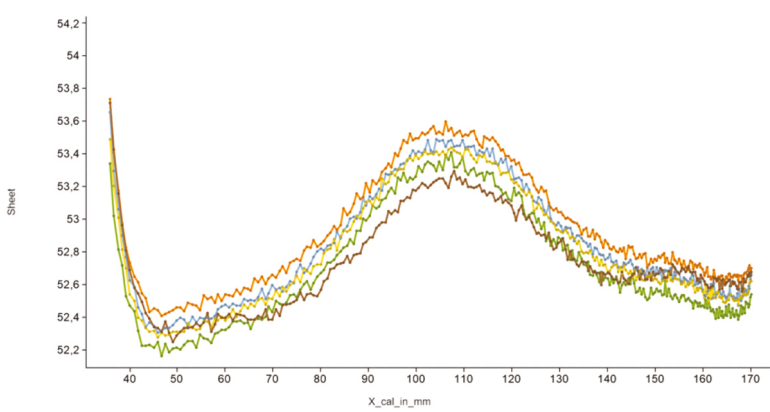
Sensor Integration Examples for Batch Processing



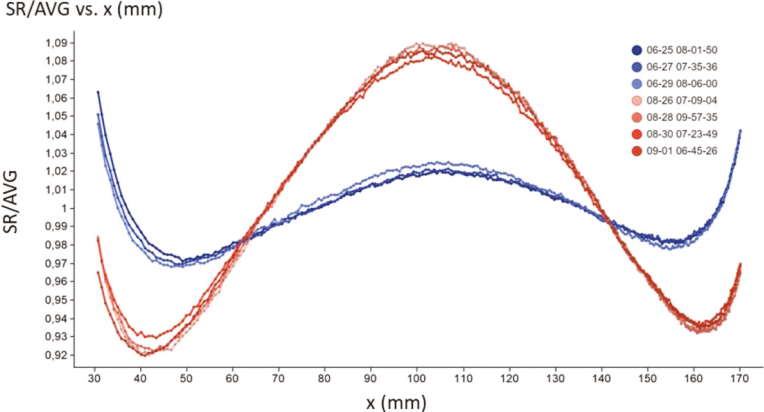
Wafer Processing in Semiconductor Supply Chain



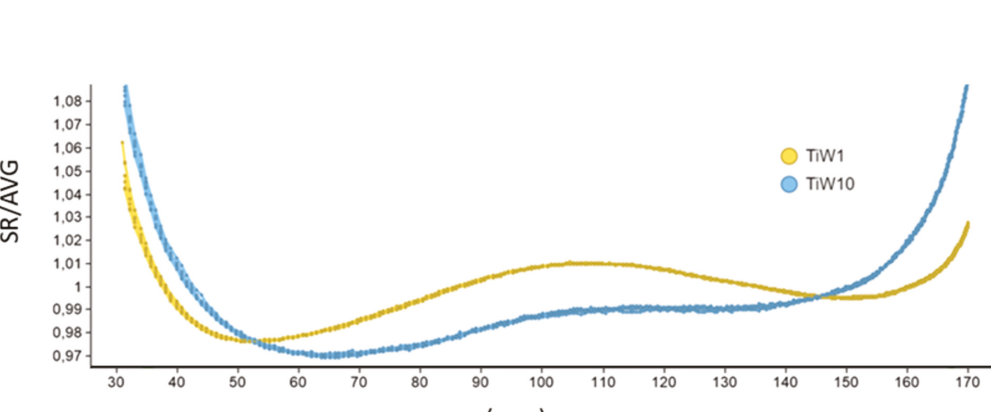
Repeatability Measurements



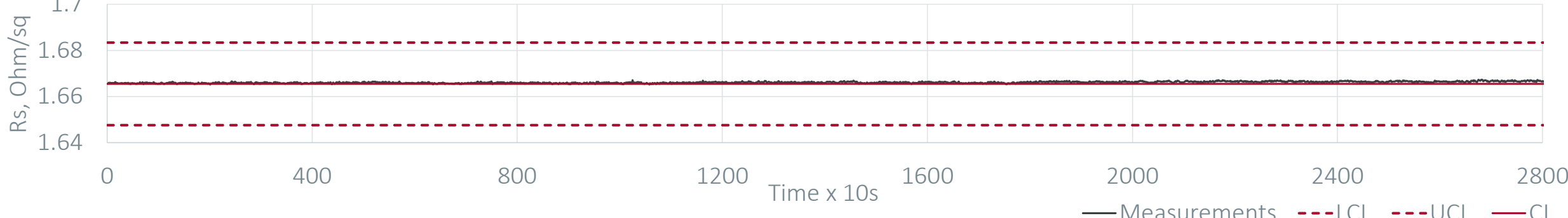
Target Lifetime Measurements



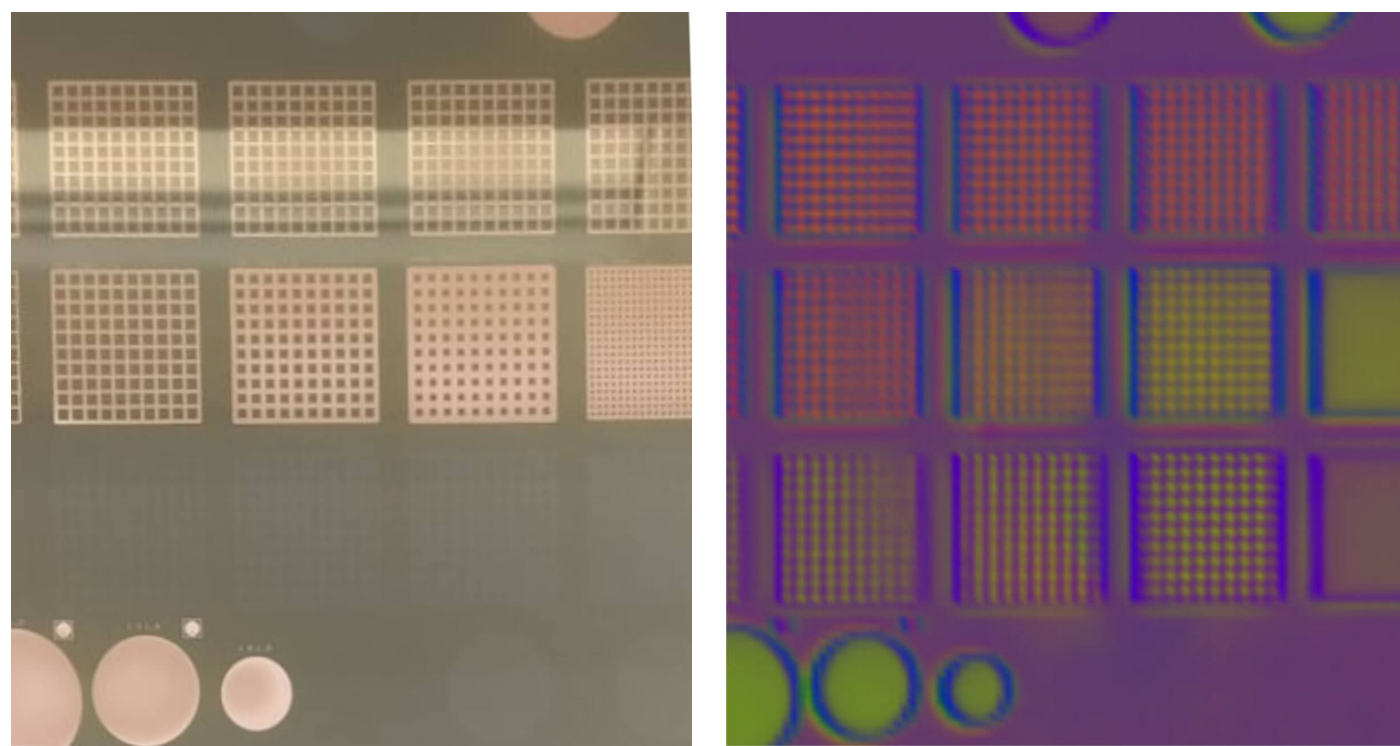
Wafer to Wafer & Chamber to Chamber Effects



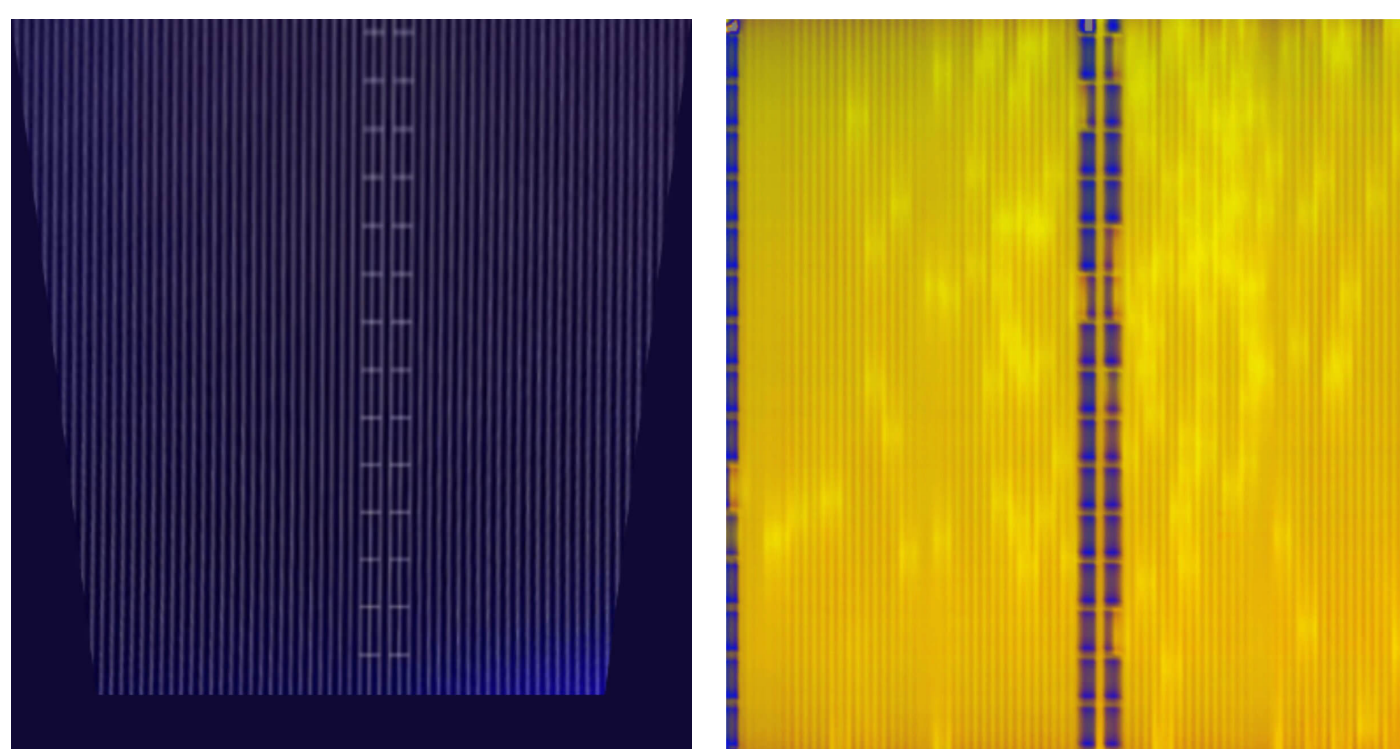
Long-time Stability (8 hours)



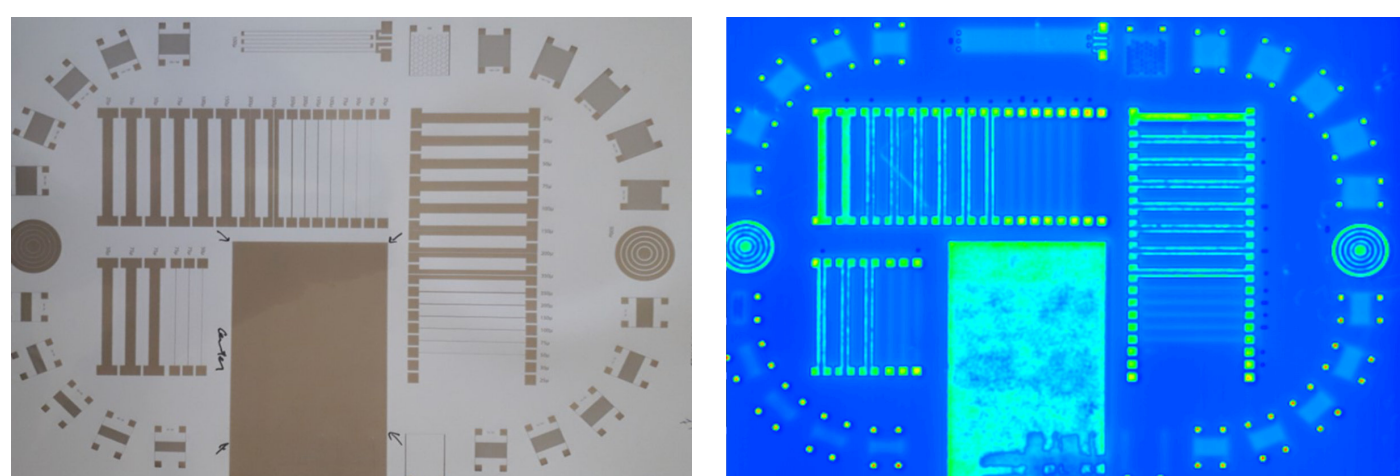
Example Photo and Corresponding Scan of a Test Structure of Printed Electronics



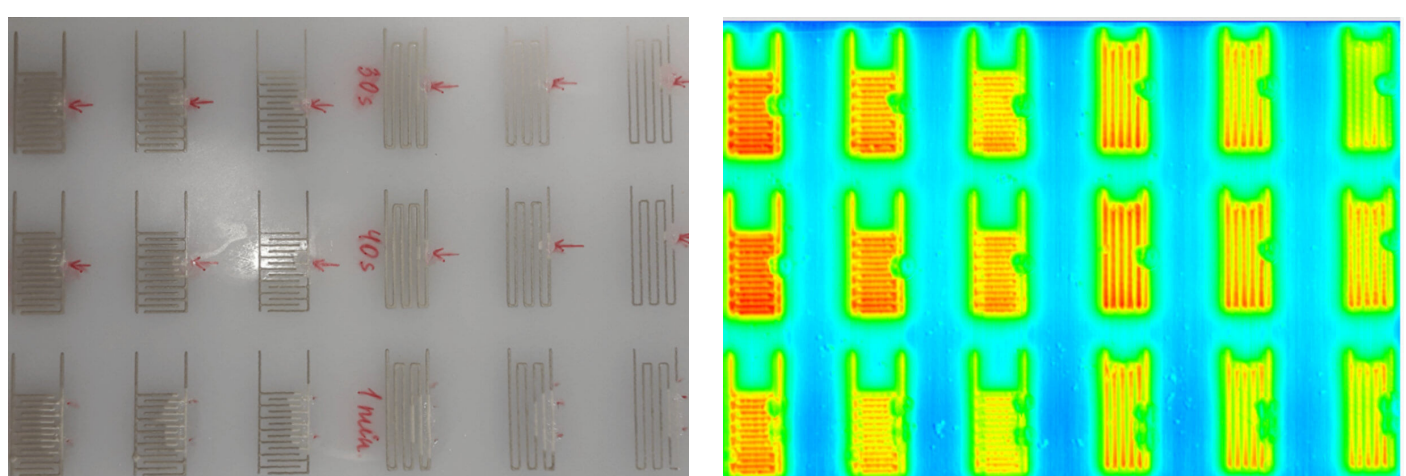
Sample Scan of a Crystalline Solar Cell



Example Photo and Corresponding Scan of a Test Structure of Printed Electronics



Example Photo of Printed Device and Eddy Current Scan



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