



ISRA
VISION



Advanced Quality Inspection and Data Analysis

Increased process yield and efficiency
for solar cells and modules



ISRA
VISION

■ Part of Atlas Copco Group



ISRA VISION



Highest cell & module efficiency: Deliver confidently world-class solar products



Lowest operation costs: Optimize resources, reach peak performance



Rapid ramp up: Fast-track production ramp-up for quicker returns

HOW TO MASTER CELL EFFICIENCY AND PRODUCTION YIELD

The demand for high-performance solar cells and modules is growing at an almost unstoppable pace. At the same time, manufacturers need the highest quality with maximum throughput to produce economically.

Inspection is the key to ensuring low operating costs and high cell and module quality. ISRA VISION / GP Solar belongs to the leading inspection providers for the entire PV manufacturing chain. Our innovative inspection technology is particularly designed to ensure:

1. Highest cell efficiency

Advanced defect recognition technology increases cell efficiency to unprecedented levels. By quickly identifying defects, we maximize the performance of each solar cell, resulting in superior energy conversion rates and higher yields.

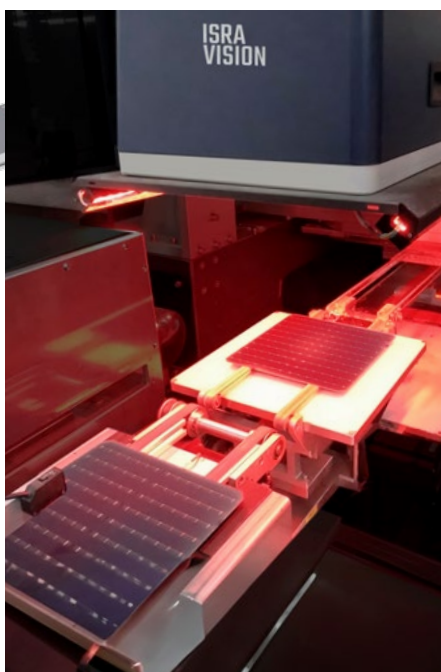
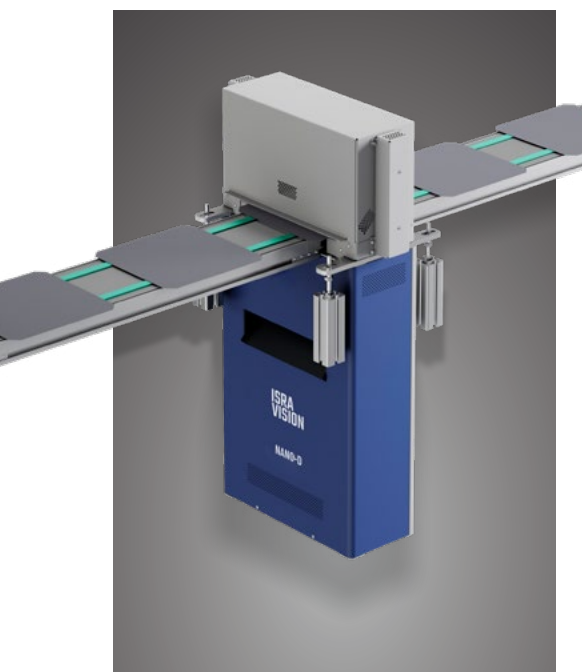
2. Maximum equipment availability and performance

Using real-time data and predictive maintenance algorithms, we maximize uptime and ensure that PV manufacturing equipment is operating at peak efficiency. This approach not only improves overall equipment effectiveness (OEE), but also optimizes the effort associated with setup and commissioning.

With our comprehensive understanding of the PV production process, we ensure advanced quality inspection and insightful process analysis. Our customers benefit from maximum cell & module efficiency, cost-effectiveness, and peak performance.

As a part of the Atlas Copco Group, our global network empowers us to provide fast and responsive service and support.

- Advanced inspection & data analytics solutions to increase cell efficiency and process yield
- Supporting all cell technologies: TopCon, HJT, xBC, Perovskite, tandem technologies
- Process competence & integration expertise up to multi-GW scale



INSPECTION FOR ALL CELL TECHNOLOGIES

Solar cells are constantly being developed to optimize efficiency, cost and lifetime. Each cell technology has specific characteristics that require tailored inspection methods to ensure quality and performance.

Under our GP Solar brand, we offer a comprehensive inspection portfolio tailored to all cell technologies. To enhance the process yield in cell and module manufacturing, our inspection solutions are applied across the following production stages:

Cell		Module	
HJT (xBC)	TopCon (xBC)	Perovskite tandem	HJT/TopCon incl. xBC
<ul style="list-style-type: none"> ■ Incoming ■ i:a-Si deposition ■ n:a-Si, p:a-Si, n:µc-Si, p:µc-Si deposition ■ TCO coating ■ Printing ■ Sorting 	<ul style="list-style-type: none"> ■ Incoming ■ Poly-deposition ■ AlOx coating ■ SiNx coating ■ Printing ■ Sorting 	<p>Bottom cell:</p> <ul style="list-style-type: none"> ■ Incoming ■ Poly-deposition ■ AlOx coating ■ SiNx coating ■ Printing ■ Sorting <p>Top Cell:</p> <ul style="list-style-type: none"> ■ TCO bottom ■ ETL/Absorber/HTL ■ TCO top ■ Printing ■ Sorting 	<ul style="list-style-type: none"> ■ Incoming ■ Stringing
<p>Full support for back contact structures (xBC):</p> <ul style="list-style-type: none"> ■ Masking layer ■ Alignment control 			

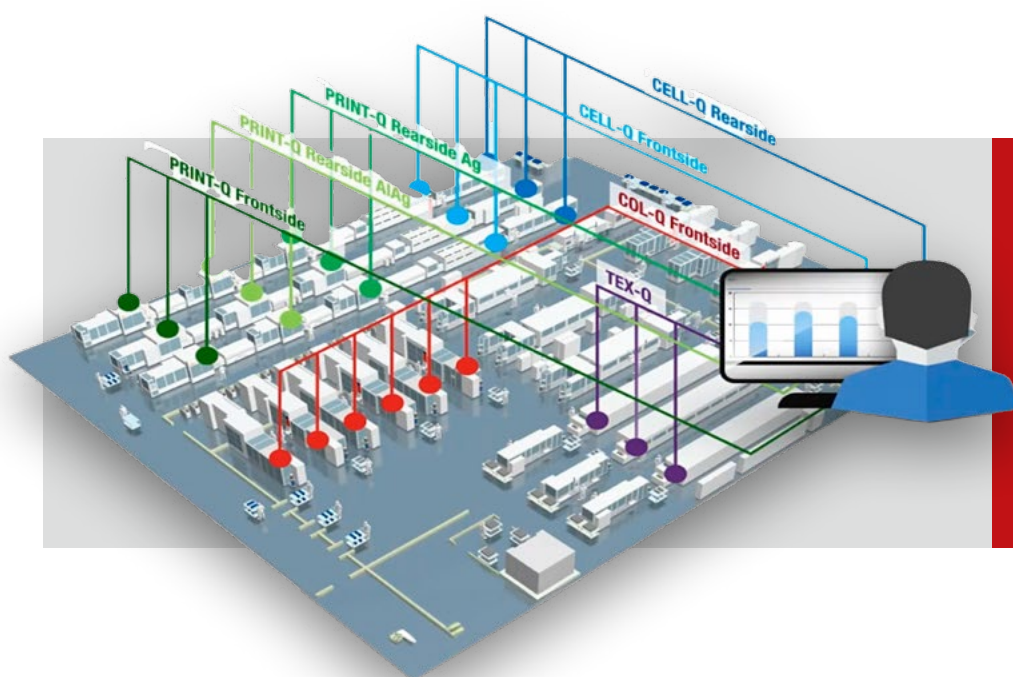


CONNECTED PV 4.0

Production Data Insights with Connected Photovoltaics 4.0. Fab data management at its core.

The complexity of modern GW multi-line production sites, often running with 20+ inspection systems on each line, requires to avoid inconsistencies in quality standards. Local management of quality settings, without standardization across the company, results in locally and globally inconsistent quality. Perfectly coordinated processes across systems, production lines, and factories are the basis for maximum profitability, reliability, and short downtimes.

This is where Connected PV 4.0 comes in. The cloud-based software solution connects inspection systems and enables consistent quality settings and process monitoring in all production plants. It collects production data, creates transparency, and improves process control, to increase the profitability of PV production.



Your benefits with Connected PV 4.0

- Maximum process transparency: Identify process weaknesses fast & easy
- Fast ramp-ups with reduced engineering work
- Increased uptime and productivity

Central Recipe Management

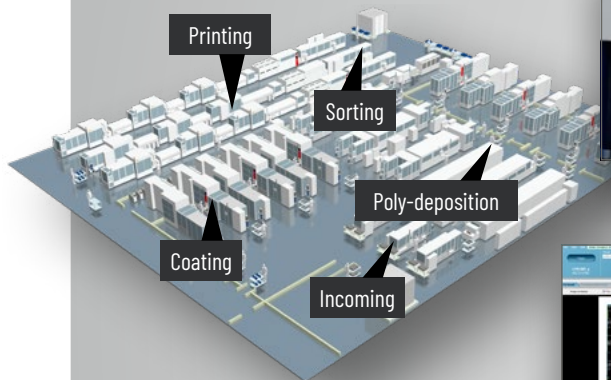
The Central Recipe Tool (CRT) allows recipe changes, including version control and approvals, to be made centrally. Identical settings are rolled out to all lines at the click of a mouse. CRT ensures globally uniform quality standards and makes plants with identical quality settings comparable.

INSPECTION SOLUTION PORTFOLIO

Depending on the cell technology, quality control can be performed at different stages of the production process. The tighter the monitoring, the faster defects are identified and process weaknesses are uncovered, thus contributing to an optimized process yield.

At ISRA VISION, we have extensive expertise in manufacturing processes and know the critical points. Our quality inspection portfolio is the answer to these challenges. All of our systems support Connected PV 4.0.

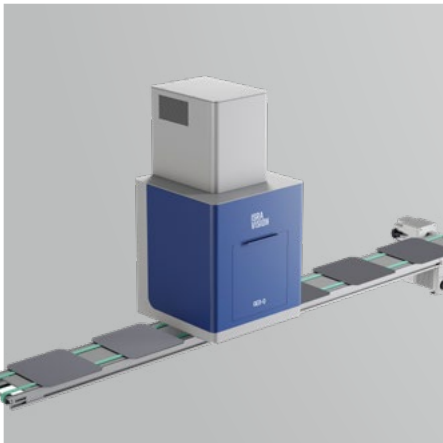
TopCon cell factory with **neuralgic process steps** (exemplary)



Inspection and data capturing with **GP Software Suite**

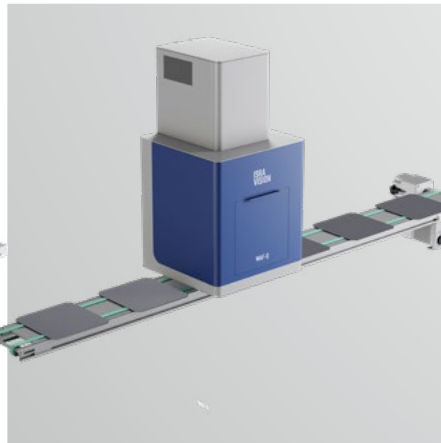


Process control and data analysis with **Connected PV 4.0**



Geometry & Contour

- Geometric irregularities
- Edge distortions
- Applicable for wafer and cell manufacturing



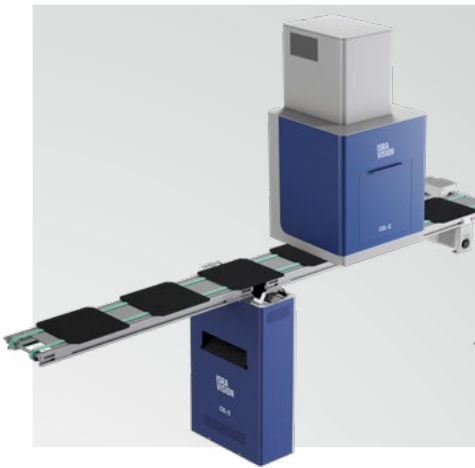
Surface Inspection

- Low contrast visual defects
- Stains, fingerprints, chips
- Applicable to wafer and cell manufacturing
- Automatic classification



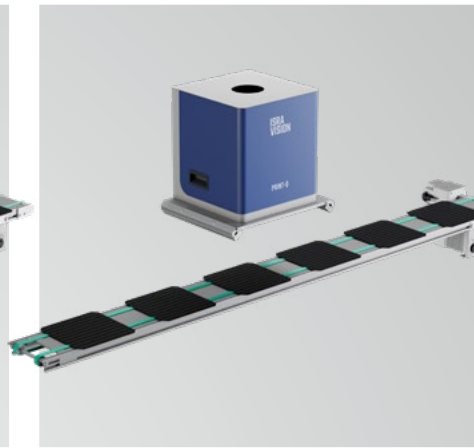
Texturing Monitoring

- Check for contaminations and defects, longterm drifts, over-etching of grain boundaries
- Inspection of homogeneity and reflectivity
- Connected PV Boat View: Heat map of the entire boat, i.e., defect visualization with respect to each wafer position in the process



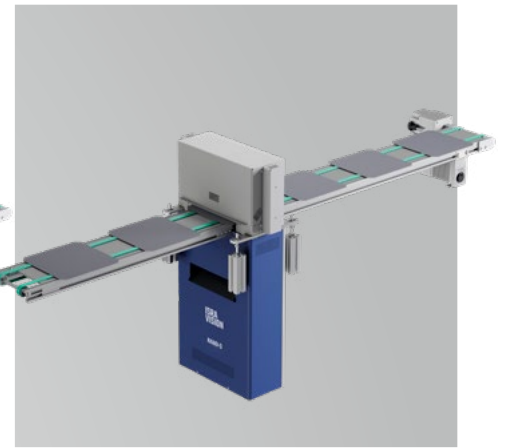
Color and Coating Monitoring

- Check for homogeneity and color value
- Check for coating defects: Color deviations, color defects, stains, local deviations in coating thickness
- Connected PV Boat View: Heat map of the entire boat, i.e., defect visualization with respect to each cell position in the process



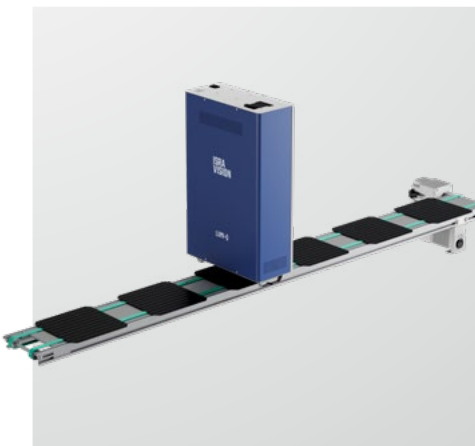
Print / Plating / Pattern & Structure Inspection

- Evaluation of the print process in terms of positioning and print quality
- Check for print defects such as finger interruptions, thickenings, paste stains, smearing
- Alignment control of the laser and print pattern



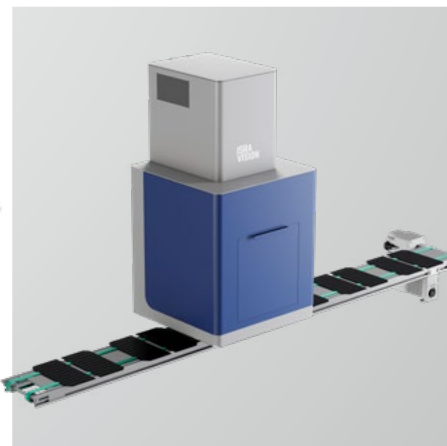
Microcrack Inspection

- Non-contact microcrack detection
- Check for contour defects and bulk material inhomogeneities
- Applicable to incoming wafer inspection and all following processes
- Cumulative defect overlay for identification of systematic faults (handling/processing)



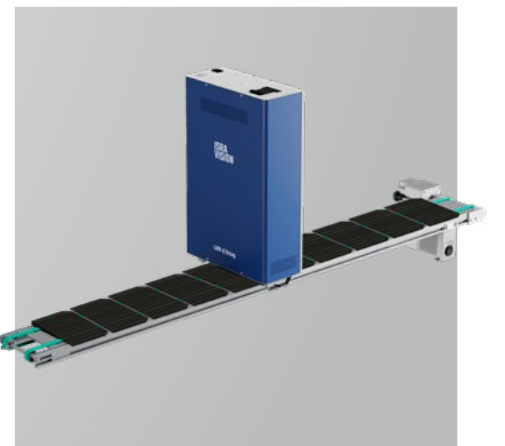
PL Inspection

- Pre/post-coating photoluminescence inspection
- Check for material and coating defects such as microcracks, impurities, crystal defects, cell breakage, scratches, stains, passivation defects
- Laser free - highest safety standards



Final Inspection & Classification

- Inspection of arbitrary print patterns for front, rear, dual, double, bifacial, IBC, or plating
- Inspection of single and multi-layer coatings for color impression and coating defects of print, coating, and cell surface
- Alignment control of the laser and print pattern



PL String Inspection

- Detection of all relevant defects on solar strings directly in stringer
- Laser-free and contactless inspection technology
- Seamless integration without additional footprint

