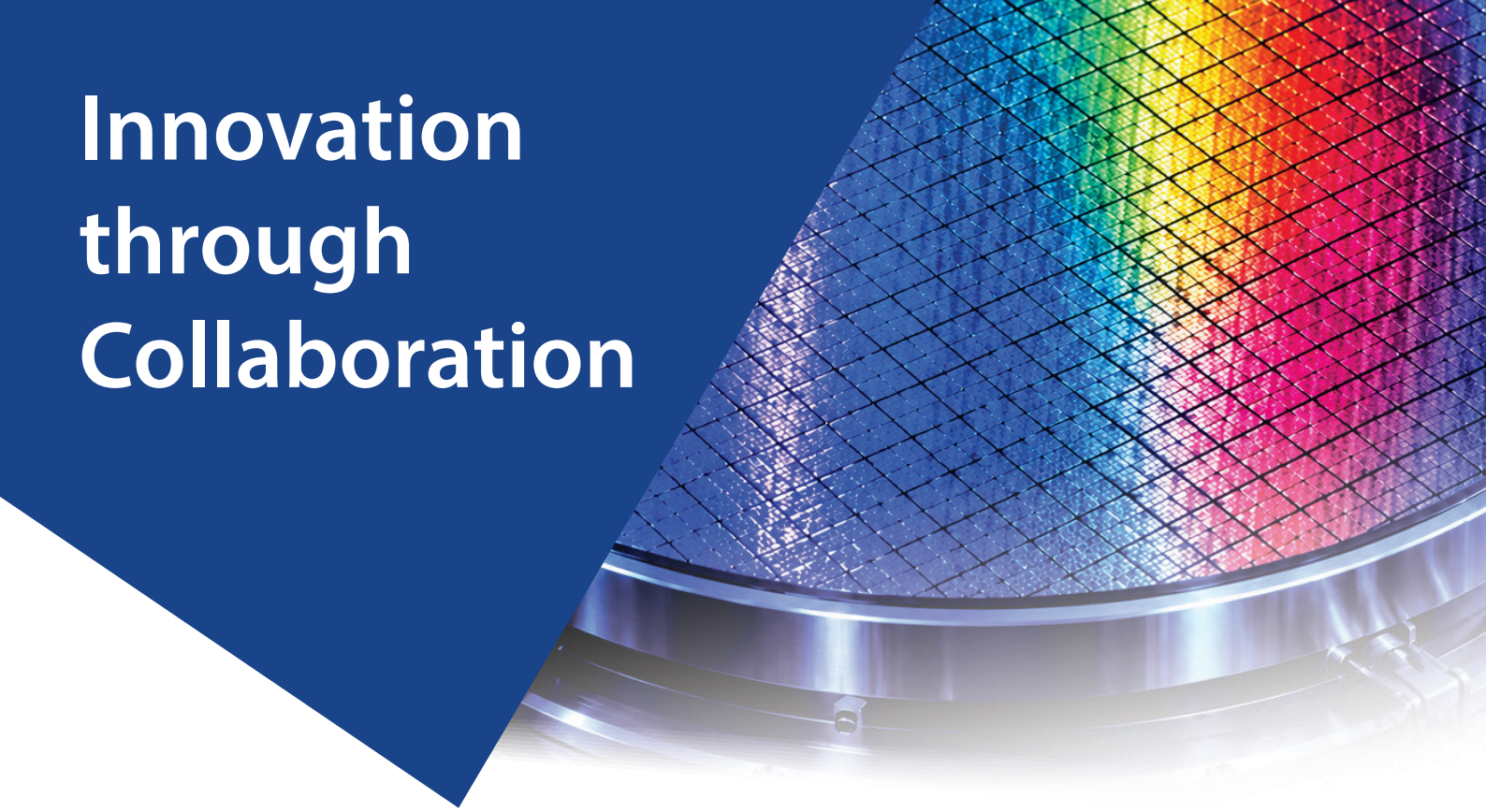
Innovation through Collaboration



From Evaluation to In-Fab Qualification in 9 Months: The Illumination Upgrade that Improved Throughput and Defect Detection

How Camtek partnered with CoolLED to achieve recipe-lock performance, Copy Exact! unit to unit variation management, and higher throughput for next-generation automated optical inspection.

Semiconductor Advanced Packaging wafer inspection is unforgiving. As the industry moves to complex Multi-RDL, FOWLP, 2.5D, smaller micro-bumps, hybrid bonding, and high-density CMOS Image Sensors, legacy illumination has become a critical bottleneck. To achieve sub-micron defect detection at production speed, Camtek, a leading semiconductor OEM, recognised that illumination needed significant improvement.

This case study explains how Camtek partnered with CoolLED to qualify a multi-wavelength LED illumination system for wafer inspection, achieving enhanced defect detection, higher throughput, recipe-lock performance, Copy Exact! Deployment ability, and field-proven reliability all validated in-fab within 9 months.

> ***"9 months from starting development to being in market with the Eagle G5 is remarkable. Our collaboration has established CoolLED as our preferred illumination partner. As inspection architectures evolve, we continue to develop next-generation tools that meet increasingly exacting optical requirements and keep our tool roadmap ahead of industry demand."***
>
> – **Benzion Sender, EVP R&D, Camtek**

Camtek
See Beyond

CoolLED
OEM Illumination

The Challenge

Camtek had clear requirements: a production-ready illumination system for demanding wafer inspection. Optical inspection tools used to identify defects, verify patterns, and maintain process consistency at increasingly small geometries are only as good as the illumination feeding them, and as requirements tighten, wavelength stability, field homogeneity, and fleet-wide consistency have become fundamental to measurement stability, throughput, and yield protection.

Additionally, the illumination source had to deliver a level of image contrast that allowed automated detection software to instantly identify defects. Soft images or subtle intensity drift would trigger false positives, slowing down scan times.

Like many OEMs operating at the leading edge, Camtek had evaluated their options including in-house illumination development, which clarified what production-ready performance was required and what kind of external partner would add value; one with deep OEM-oriented optical and illumination expertise and capability of supporting Copy Exact! rollouts across a global installed base.

The goal was to find a partner who could match Camtek's engineering rigour and provide support from technical qualification to scaled production deployment.

The Partnership

CoolLED was selected through a structured technical evaluation. Camtek assessed LED brightness, wavelength stability, homogeneity, as well as recipe-lock behaviour, designed-in practicality, and long-term support.

What emerged was a genuine co-development relationship. CoolLED worked alongside Camtek scientists and engineers to prove that the illumination system could be integrated into the inspection architecture without adding risk and was qualified against production requirements.

> ***"Mutually successful collaboration comes from a shared work ethic, close technical partnership, and a commitment to delivering results. Working with Camtek has been a real joy."***
>
> – **Louise Hedges, Sales & Marketing Director, CoolLED**

That co-development approach shifted the project from feasibility to production readiness. The outcome - equipment in-fab within 9 months of starting development with enhanced inspection and higher throughput.

Integration and Qualification

Moving from lab setup to production inspection system brings real constraints: Balancing homogeneity and brightness, mechanical interfaces, thermal management, control integration, and serviceability. CoolLED worked with Camtek throughout the design process addressing practical engineering issues before they became programme risks. The result was a smoother qualification path. Camtek validated the illumination platform in a real engineering context, confirming it met the inspection tool requirements, and moved toward production deployment with confidence. That transition from component to qualified subsystem made the partnership commercially meaningful.

Production Validation

The most important outcome of this programme was not what the platform could do in a test environment, it was what it demonstrably did in production.

Speaking with the Camtek engineering team following deployment, the feedback reflected three consistent themes.

Recipe-lock for continuous Multi-Scan Cycles

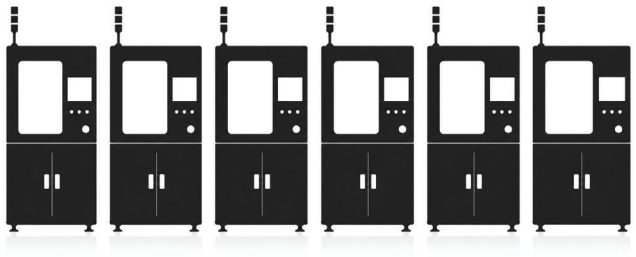
Recipe-lock was one of Camtek's most closely watched qualification criteria. Illumination sources that perform well in initial testing can drift under sustained production conditions, particularly under thermal cycling. CoolLED's platform held wavelength and intensity with consistency the team had not seen from alternatives. Once a recipe was locked, it stayed locked, so process engineers could trust tool output without building in illumination-related correction factors.

> ***"System stability is not a feature you can easily demonstrate. It's something you prove over months of production use. CoolLED proved it."***
>
> – **Camtek**

On Copy Exact! deployment

Deploying a new illumination platform across multiple tools is where many capable components fall short. Unit-to-unit variation in spectrum, intensity, or homogeneity forces tool-by-tool recalibration and weakens process-wide control. Camtek confirmed that CoolLED's manufacturing consistency translated into Copy Exact! performance across the installed base. For a semiconductor OEM serving multi-tool fabs, that reproducibility is a prerequisite.

> ***"When the tenth tool behaves the same as the first, that's when you know the illumination supplier genuinely understands production."***
>
> – **Camtek**



LEDs driving higher throughput

What mattered most was field evidence: tools running in production, delivering higher throughput, accumulating hours, and not generating service calls. Camtek could point to a population of tools in the field, operating across multiple customer sites, giving Camtek confidence in long-term deployment.

> ***"What made the results exciting was seeing the evidence from our customers."***
>
> – **Camtek**

Why It Matters

Advanced packaging inspection faces two intensifying pressures: throughput demands that require faster imaging without sacrificing resolution, and yield sensitivity that makes consistent illumination central to defect detection.

The Camtek deployment showed what resolving both pressures looks like in practice. Throughput increased while sub-micron resolution was maintained across multi-layer RDL inspection at full production speed. Bright, stable and consistent illumination improved defect detection consistency, reducing the risk of missed defects and yield loss.

> ***"Developing a bright, stable, and consistent LED illumination system for one of the toughest inspection markets has pushed LED technology to the cutting edge of what is possible from any illumination source. It has been a fantastic technical challenge, and we're delighted with the results."***
>
> – **Gerry Whoriskey, Technical Director, CoolLED**

Co-development between Camtek and CoolLED delivered operational advantage in high-volume inspection. CoolLED did not simply provide a light source; they provided a validated illumination subsystem that Camtek could qualify, deploy, and stand behind with its own customers.

t: **+44 (0)1264 323040** (Worldwide)
e: **info@CoolLED.com**

CoolLED
OEM Illumination
A Judges Scientific company