Groundbreaking quantum project aims to remove bottlenecks in chip production

With an investment from Innovation Fund Denmark, a Danish-Dutch consortium is developing the next generation of failure analysis tools for the semiconductor industry. The NG-QDMM project aims to make it possible to map electrical failures in advanced microchips quickly, accurately, and without destroying the components – thereby reducing waste, shortening development time, and strengthening Europe's technological sovereignty.

Modern microchips are the foundation for everything from artificial intelligence and 5G to electric cars and green energy. But, as chip architectures become three-dimensional and increasingly complex, fault and quality control have difficulty keeping up. Today, it can take weeks to locate a fault in an advanced chip – often using destructive methods that require the component to be cut open.

The new research project **NG-QDMM (Next Generation Quantum Diamond Magnetic Microscope)** will fundamentally change this. Innovation Fund Denmark is investing DKK 28.8 million in the project through its Grand Solutions program.

A magnetic "X-ray" of electric currents

The project is developing a quantum-based measuring instrument that, using so-called NV centers in synthetic diamond, can measure the extremely weak magnetic fields that electric currents create inside a chip. The technology makes it possible to visualize current flows in real time with sub-micrometer resolution – without physical contact and without damaging the component.

The goal is to deliver a fully integrated prototype that can be installed directly in industrial failure analysis laboratories. At the same time, the project is designed with a clear development ladder: from advanced failure analysis to near-line metrology and, in the long term, in-line production monitoring. The technology is therefore not only intended to explain why a chip fails, but also to contribute to ongoing process optimization and real-time quality control in the production itself.

> "The semiconductor industry is facing a growing diagnostic and yield problem. Chips are becoming more complex, and advanced 2.5D and 3D integration in particular are putting pressure on existing analysis tools. With this new project, we are introducing a new measurement modality that makes it possible to see

electrical currents three-dimensionally and without destroying the component. This provides both faster failure analysis and a foundation for moving measurements into production and thus preventing failures before they develop into costly yield losses," says Marvin Holten, CTO of Diasense.

Faster time-to-market and less waste

Today, new chip designs can require three to five rounds of defect revisions before production reaches satisfactory yield. Each iteration can cost millions and delay market introduction by several weeks.

The project is expected to significantly reduce analysis time and in many cases save one full round of troubleshooting. In the long term, the perspective goes beyond traditional failure analysis: By moving the technology into the production line, the measurements can be used to detect process deviations earlier and thus prevent failures before they develop into costly yield losses. This can mean faster time-to-market and lower material waste – an important contribution to both competitiveness and sustainability in an industry where even small improvements have major economic consequences. At a time when the global boom in AI chipsets is being slowed by low yields in advanced packaging methods such as 2.5D and 3D integration, more precise and production-close electrical imaging can become a key to identifying and remedying the failure mechanisms that today constitute a real bottleneck for scaling.

At the same time, the project addresses a strategic need in Europe and strengthens the collaboration between Danish and Dutch players in the European semiconductor value chain. Advanced failure analysis capacity is currently concentrated in Asia and North America. By building strong quantum-based diagnostic tools in Denmark and Europe, the research project contributes to strengthening the European semiconductor value chain in line with the ambitions of the EU's Chips Act.

From quantum physics to industrial solution

Based on 15+ years of research at the Physics department of DTU, the project brings together leading Danish and European competencies within quantum physics, metrology, and industrial testing. Diasense leads the development of the overall instrument, while DTU will develop advanced quantum sensor protocols and explore fundamental limits. FORCE Technology and DFM ensure industrial integration and traceable calibration, and Eurofins MASER stands for industrial validation in real failure analysis cases.

Together, the partners will develop a robust, user-friendly, and scalable platform that can become a new standard within semiconductor diagnostics.

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About the partners

Diasense ApS is a Danish deep-tech company and spinout from DTU, developing quantum-based magnetic microscopes for advanced failure analysis and metrology.

Technical University of Denmark (DTU) contributes with internationally leading research in quantum sensors and NV-based magnetometry.

FORCE Technology is a Danish GTS institute with strong competencies in test, electronics, sensors, measurement technology and industrial integration.

DFM (Danish Fundamental Metrology) is developing the optical package, while ensuring traceable measurement methods, standards, and metrological quality.

Eurofins MASER (Netherlands) specializes in semiconductor diagnostics and validates the system on a broad portfolio of advanced chip and package technologies and benchmarks the performance directly against existing state-of-the-art analysis tools.