

Next Generation Combat Aircraft Technologies - NGCAT

ACRONYM: QuantumSight

Title: Miniaturized Augmented Infrared Vision for Air Defense with Supply Chain Sovereignty

Duration of the project: 01/05/2025 - 01/02/2028

Total budget: 3 715 154 €

Key words: SWIR, Quantum dots,
hyper/multispectral, miniaturization

of which RHID contribution: 3 601 000 €

PROJECT DESCRIPTION

Modern airborne defence systems increasingly depend on advanced imaging technologies to perform effectively in diverse and challenging environments. Short-Wave Infrared (SWIR) imaging offers distinct advantages, including visibility through fog, haze, and smoke, enhanced object recognition, and laser detection. However, current SWIR cameras face limitations such as high cost, large form factors, and limited resolution.

The QuantumSight project addresses these challenges by developing a compact, high-resolution, high pixel density, and cost-effective SWIR image sensor based on quantum dot (QD) technology. The project brings together a consortium of complementary partners—QustomDot, Imec, Xenics, CSL, and RMA—each contributing specialized expertise across the value chain, from QD material synthesis to sensor integration, reliability testing, and use-case validation.

This innovation supports the EU's Strategic Compass objectives by strengthening defence capabilities and reducing technological dependencies, thereby reinforcing a robust European Defence Technological and Industrial Base (EDTIB).

Project Objectives

QuantumSight aims to develop a novel SWIR image sensor using heavy-metal-free, non-restricted colloidal quantum dots monolithically integrated with a custom-designed Readout Integrated Circuit (ROIC). The primary goals include:

- Use-case validation for compact SWIR cameras (e.g., drones, helmets).
- Design of a custom ROIC with programmable features and targeting low cost in production.

- Integration of a non-restricted QD photodiode stack into the image sensor, leveraging a predominantly Belgian and fully EU-based supply chain.
- Demonstration and testing of a camera prototype in real-world outdoor defence scenarios.

Project Phases

Phase 1: Preparation

- Define key use-case scenarios, particularly for air defence.
- Initiate development of QD-based imaging technology, including material synthesis, pixel stack design, and integration with a new ROIC tailored for advanced imaging.

Phase 2: Fabrication

- Develop and integrate hardware for the final camera demonstrator.
- Establish the QD stack integration process and test upgraded materials and ROIC.
- Conduct reliability testing, explore multi-band functionality, and refine image processing algorithms.

Phase 3: Verification

- Assemble and characterize the complete image sensor demonstrator.
- Perform reliability testing and evaluate performance in refined use-case scenarios.
- Finalize reporting, dissemination, and outreach activities.

Consortium Roles

QustomDot – Quantum dot synthesis

imec – Sensor integration

Xenics – ROIC design and camera development

CSL – Reliability testing

RMA – Use-case validation and image analysis

Strategic Impact and Innovation

QuantumSight explores how SWIR imaging can enhance vision by identifying scenarios and object types best detected with SWIR cameras. The project aims to miniaturize SWIR cameras to smartphone-sized devices, enabling integration into defence tools such as drones.

Driven by a fully Belgian consortium, the project emphasizes supply chain independence. All the components are manufactured in Belgium with exception of the CMOS front-end which is sourced from within the EU. The monolithic integration of the new sensor design enables scalable and cost-effective manufacturing, potentially reducing sensor costs from €1000 to under €100. This cost efficiency comes with added value of higher resolution, larger sensor formats, and the use of environmentally friendly, robust QD materials.

The project aligns with the strategic goals of all partners (Xenics, IMEC, QustomDot, RMA and CSL), ensuring long-term maintainability, market, and technology relevance. It also addresses critical gaps

in European defence technology by offering a competitive alternative to non-EU SWIR solutions, reinforcing the EU's technological sovereignty.

Expected Outcomes

1. Identification and validation of air-defence use cases enabled by SWIR imaging.
2. Development and analysis of a novel SWIR image sensor based on lead-free QDs.

Additional deliverables include:

- A prototype SWIR camera system
- Technical reports on use cases, sensor specifications, and performance
- Publications in top-tier conferences (e.g., IEEE-IEDM)
- Outdoor validation data and image processing results for military-relevant scenarios
- A roadmap for production scaling and commercialization

In the short term, defence stakeholders and potential industrial users will evaluate the prototype. In the medium term, commercialization will proceed through Xenics' global sales network, targeting defence, industrial, medical, and agricultural markets. The EU-based supply chain and scalable manufacturing process will ensure long-term sustainability and strategic value.

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LINK(S)

NA