EffiTrap: comprehensive and real-time defect analysis for semiconductors

A technology that provides advanced defect characterization for semiconductors, including imaging sensors, optical sensors, bio sensors, photodetection, laser processing materials, and photovoltaics.

Proposed Use

EffiTrap is a cutting-edge, non-invasive defect detection technology funded by Innovate UK. It delivers high-resolution, 4D defect detection by combining spatial, depth, and time-transient measurements. EffiTrap uniquely detects both visible and invisible defects in under 0.5 seconds, making it ideal for real-time QA/QC and R&D applications. Validated on materials like SiC, GaN, and perovskites, EffiTrap has been demonstrated its industry-leading innovation and reliability. Its automatic trap mapping capability further streamlines defect analysis by automatically localising and classifying defects.

Problem Addressed

In semiconductor and optoelectronic manufacturing, undetected defects significantly compromise device performance and reliability. Current tools like photoluminescence (PL), scanning electron microscopy (SEM), and transient absorption spectroscopy (TAS) are slow, invasive, and limited to surface-level or visible defects. These limitations hinder in-line quality assurance and production efficiency.

EffiTrap solves these challenges by providing comprehensive 4D defect detection and detailed data on defect density, energy depth, and carrier lifetime. Its ability to detect all defects—including invisible and subsurface ones—sets a new benchmark in defect characterisation, helping manufacturers reduce waste, optimise production, and meet the stringent demands of advanced materials like perovskites and SiC.

Technology Overview

EffiTrap employs advanced optical techniques to achieve 4D defect detection, enabling comprehensive spatial mapping and analysis of defects in semiconductor materials. It offers detailed, non-invasive insights into defect density, energy depth, and carrier lifetime, ensuring materials remain intact for further processing.

Its fast scanning capability (<0.5 seconds per scan) makes it highly suitable for real-time, operando analysis in production lines. Its automatic trap mapping feature provides automated localisation and classification of defect types, streamlining workflows for both R&D and production environments.

Benefits

- Detects 100% of visible and invisible defects, ensuring top-quality, reliable products.
- Identifies defects early, reducing scrap rates by up to 50%
- Scans in <0.5 seconds, ideal for high-speed production lines and immediate quality control.
- Lowers waste and rework needs by up to 30%, saving time and resources.
- Provides data on defect density, energy depth, and lifetime, boosting understanding and performance.
- Works with SiC, GaN, silicon, and other materials, supporting cutting-edge applications.
- Uses non-invasive methods, preserving materials while ensuring thorough inspections.
- Helps deliver premium products, enhancing brand reputation and customer trust.
- Helps manufacturers save £10M–£25M annually, boosting operational efficiency.

Edmond Yau

Commercialisation Executive – Faculty of Natural Sciences

h.yau@imperial.ac.uk

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Technology Overview (continued)

With the ability to reduce material waste and rework by up to 60% and save manufacturers £10M–£25M annually for a 500 MW production scale, EffiTrap transforms quality assurance processes.

EffiTrap's integration into production environments ensures high yields, premium product quality, and optimised performance across a variety of semiconductor types, including SiC, GaN, silicon, and perovskites.

Intellectual property information

A priority patent application has been filed for this technology, GB2417699.2

Inventor information

Dr Artem Bakulin

Reader, Department of Chemistry

Dr Jiaxin Pan

Research Associate, Department of Chemistry

Dr Ziming Chen

Senior Research Associate, Department of Chemistry