



WELCOME TO PHOENIX FOURTH NEWSLETTER



FERROELECTRIC PHOTONICS ENABLING NOVEL FUNCTIONALITIES AND ENHANCED PERFORMANCE OF NEXT GENERATION PICS

Join us as we explore recent achievements, milestones, and a look ahead at upcoming initiatives in the PHOENIX project. Ferroelectric photonics continues to drive innovation across next-generation photonic integrated circuits (PICs).

>>> **PHOENIX at ECIO 2025: Cardiff University**

The **PHOENIX project** was proud to be an official **exhibitor** at the **26th European Conference on Integrated Optics (ECIO 2025)**, held from **10–12 June 2025** at **Cardiff University**.

As one of Europe's leading events in photonic integration, ECIO 2025 offered a dynamic platform to present PHOENIX's latest advances in ferroelectric photonics and next-generation photonic integrated circuits (PICs).



EUROPEAN
CONFERENCE ON
INTEGRATED OPTICS

Representing the project, Valentín Polo from **PNO Innovation Spain** showcased our progress and connected with a broad community of experts and innovators.

The event was also a valuable opportunity to **network and build synergies with other EU-funded projects**, strengthening collaborations and aligning efforts toward common innovation goals in photonics, quantum, and neuromorphic technologies.

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Results and Outlook

Over the first **30 months**, we achieved significant technical milestones:

- ❑ **Materials and Device Development:** VOx deposition on BTO surfaces with optimized annealing and characterization.
- ❑ **Waveguide Fabrication:** Process optimization for hybrid VOx/BTO devices and development of VOx etching recipe
- ❑ **PIC Design:** Finalization of the multi-process wafer run for chip-level demonstrators.
- ❑ **Use Cases:** Designs targeting photonic engines for **deep neural networks** and **fully homomorphic encryption**.

In the remaining 12 months, we aim to:

- ❑ Perform dielectric response limit calculations.
- ❑ Conduct ex-situ **THz characterization** of dielectric losses.
- ❑ Finalize and evaluate use case demonstrators and hybrid VOx/BTO devices.



New Promotional Material

- ❑ We launched a fresh suite of PHOENIX promotional resources, revealed at ECIO 2025! These materials outline the project's mission, partners, and technological objectives. Ideal for presentations, outreach, and stakeholders. **Download Now !**



Ferroelectric PHOTonics Enabling novel functionalities and enhanced performance of neXt generation PICs



ABOUT THE PROJECT

In PHOENIX, "Ferroelectric PHOTonics Enabling novel functionalities and enhanced performance of next generation PICs", funded by the EU Horizon Europe programme (GA 101070690), a consortium formed by Partners Lumiphase (CH), Optalysys (UK), IBM Research (CH and IL), Nanophotonics Technology Center - Universitat Politècnica de València (UPV) (ES), PNO Innovation (ES), and the Institute of Physics of the Czech Academy of Sciences (FZU) (CZ), coordinated by KU Leuven (BE), have joined their forces to

create building blocks for the next generation of encryption and computing hardware. They will leverage compact photonic integrated circuits (PIC) offering a continuous and efficient control over optical signals. The PIC chips are based on Lumiphase's proprietary technology, and enhanced with novel functionalities using materials developed at KU and UPV. Epitaxial technology will be advanced through the realization and upscaling of high-quality oxide thin-films.

RESULTS AND OUTLOOK

In the first 30 months of the project we have screened and identified the requirements for material, device and hardware design for the demonstrators. Deposition of VOx on BTO surfaces, annealing and material characterization was performed to identify the process conditions for the manufacturing of hybrid VOx/BTO devices. In addition, the PIC for the first multi-process-wafer round was released. We have been working on PIC design to manufacture the first chip demonstrator to validate basic functionalities using BTO technology, as well as to manufacture the first demonstrator as a photonic engine for deep neural network and for fully homomorphic encryption.

In the last 12 months of the project, we will perform calculations to determine the limits of the dielectric response in the PIC materials and perform ex-situ THz characterization of the dielectric losses. Ultimately, the full set-up of the use cases demonstrators will be built and evaluated.



CONSORTIUM



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OBJECTIVES

The developed technology will be used to demonstrate its benefits in four high-impact emerging applications:

- 1 fully homomorphic encryption (Optalysys, IBM Research)
- 2 5G infrastructure (Optalysys)
- 3 Inference of deep neural networks (IBM Research), and
- 4 training of deep neural networks (IBM Research).

IMPACT

The validation of the developed technologies will be completed with an extrapolation to benchmark against representative existing systems and a roadmap for photonic-electronic integration. The project will perform a market analysis and a techno-economic evaluation to define business models and exploitation plans that ensure the sustainability of the PHOENIX platform to reduce innovation-to-market-time and R&D costs for disruptive high-tech SMEs and maximize the impact of the 4 user cases demonstrators.

RESULT AND OUTLOOK

In the first 30 months of the project we have screened and identified the requirements for material, device and hardware design for the demonstrators. Deposition of VOx on BTO surfaces, annealing and material characterization was performed to identify the process conditions for the manufacturing of hybrid VOx/BTO devices, while fabrication and optical characterization of waveguides was performed to identify the process conditions for the manufacturing of hybrid VOx/BTO devices. In addition, the PIC for the first multi-process-wafer round was released. We have been working on PIC design to manufacture the first chip demonstrator to validate basic functionalities using BTO technology, as well as to manufacture the first demonstrator as a photonic engine for deep neural network and for fully homomorphic encryption. In the last 12 months of the project, we will perform calculations to determine the limits of the dielectric response in the PIC materials and perform ex-situ THz characterization of the dielectric losses. Ultimately, the full set-up of the use cases demonstrators will be built and evaluated.

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Achievements and Future Plans

In the past months, PHOENIX has:

- ❑ Published new results on photonic neural networks.
- ❑ Demonstrated hybrid PIC components.
- ❑ Strengthened international collaboration.

Looking forward:

- ❑ We aim to extend applications to AI acceleration and encrypted photonic computing.



DISSEMINATION & EXPLOITATION

Our communication team has amplified PHOENIX's visibility via web and social media. Here are some recent activities:



Photonics21 Innovation Award 2025 – A Unique Opportunity for Photonics Innovators



Celebrating the International Day of Women and Girls in Science



New Publication: Advancing Photonic Neural Networks



PHOENIX , Exhibitor at ECIO 2025!



Celebrating World Quantum Day from the PHOENIX Project!



Celebrating the International Day of Light 2025



PHOENIX Contributes to Shaping the Future of Photonics at the Photonics Partnership Annual Meeting 2025



PHOENIX at ECIO 2025 – Cardiff Highlights

Meet new PHOENIX partner FZU!



We welcome **FZU (Institute of Physics of the Czech Academy of Sciences)** as a new PHOENIX partner! Based in Czechia, FZU brings:

- Expertise in **ferroelectric films and dielectric materials**.
- Advanced **thin film modeling** for BTO-based PICs.
- High-precision measurements that strengthen the scientific foundation of our use cases.

READ MORE →

"Our expertise in ferroelectric films will enrich the PHOENIX consortium's capabilities and help pave the way for innovation in PIC-based encryption and AI." – FZU Team

Stay Connected!



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