DECEMBER, 2025

NEWSLETTER

ISSUE 2

KEY FACTS

7 Partners

4 European countries

4 Years

3.6M+ EUR funding

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WELCOME TO OUR 2ND PIONEAR NEWSLETTER!

Dear Reader,

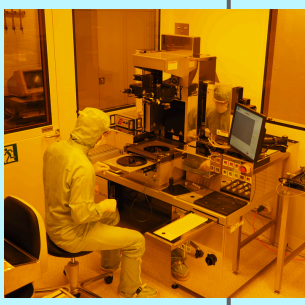
We are glad to bring you the second edition of PIONEAR newsletter.

Inside, you will find a sneak peak at PIONEAR's recent achievements from the Institute of Microtechnology and Photonics (IMP at OST), The Łukasiewicz – Institute of Microelectronics and Photonics (L-IMIF) and the Lodz University of Technology (TUL).

You will also hear the main takeaways from recent meetings and our partners talking about their experience in developing a novel photonic microphone.

To end will introduce you more consortium partners: VIGO photonics and L-IMIF, offering a closer look at their contributions to the project and the upcoming events where you could find them!

We hope you enjoy the read!
accelopment on behalf of the project consortium



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Progress:

A sneak peak at PIONEAR's recent achievements from our partners

IMP, OST: Precision Parts for Future Photonics

At the Institute of Microtechnology and Photonics (IMP at OST), we're optimizing mechanical structures for high-tech devices, from optimizing microphone parts like the acoustic chamber and membrane to engineering better optical systems. Our work includes developing specific mechanical structures to efficiently guide laser light from acoustic sensor to the wavelength meter via a coupling fiber.

A big leap is our new fiber port. Developed for optical packaging, it enables highly efficient coupling and alignment within glass components. We achieve this through advanced Selective Laser Etching (SLE) in fused silica. The design is innovative: a vertical V-groove, alignment marks, and a flexible glass spring ensure precise fiber positioning. This robust system delivers a mean coupling efficiency of 70% and superior accuracy. This innovation is a major step forward, offering both robust performance and easy manufacturability for tomorrow's compact photonic systems.

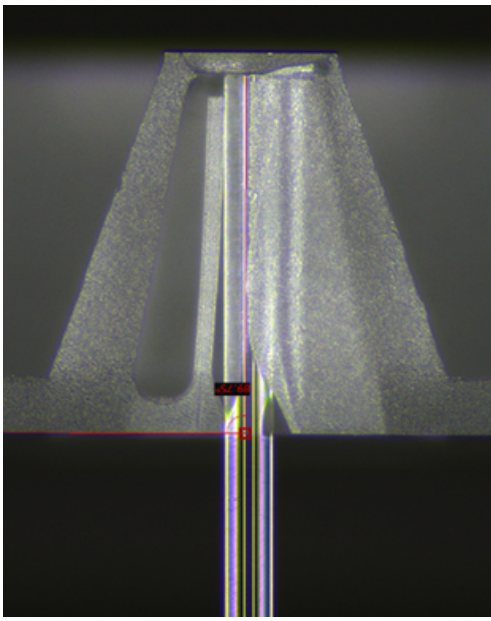

Figure provided by OST.
Cross section of fiber port.

L-IMIF: Developed VCSEL coupon manufacturing technology

One of the tasks within the PIONEAR project is the development of an electrically pumped VECSEL laser based on arsenide materials, emitting at a wavelength of 940 nm.

The laser is to be fabricated in the form of a coupon, which will then be transferred to its target location - the acoustic chamber of the developed microphone using a micro-transfer printing technique. The coupon fabrication technology was developed by Ł-IMIF and evaluated by UCC in terms of its suitability for the micro-transfer printing process. Following a positive evaluation, the developed technology was implemented for the construction of a fully processed, electrically pumped VECSEL laser demonstrator.

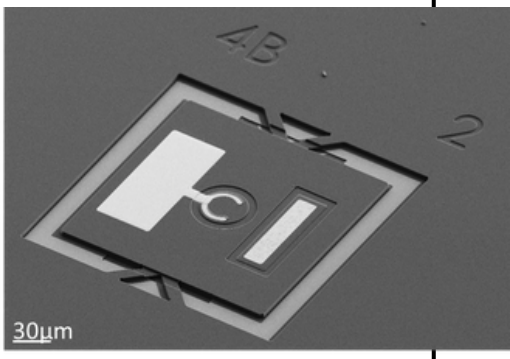

Figure provided by L-IMIF.
Cross section of fiber port

TUL: PIONEAR's achievements from Lodz University of Technology

At the Lodz University of Technology, our team focuses on the numerical design of semiconductor laser structures and the experimental testing of fabricated samples. We have designed the first versions of the structures, carefully optimizing the thickness and position of each layer. The samples, grown by VIGO Photonics and processed by the Łukasiewicz Institute of Microelectronics and Photonics, are now under experimental evaluation in our laboratory. This stage allows us to verify their performance, compare the results with simulations and identify potential improvements for the next generation of designs.

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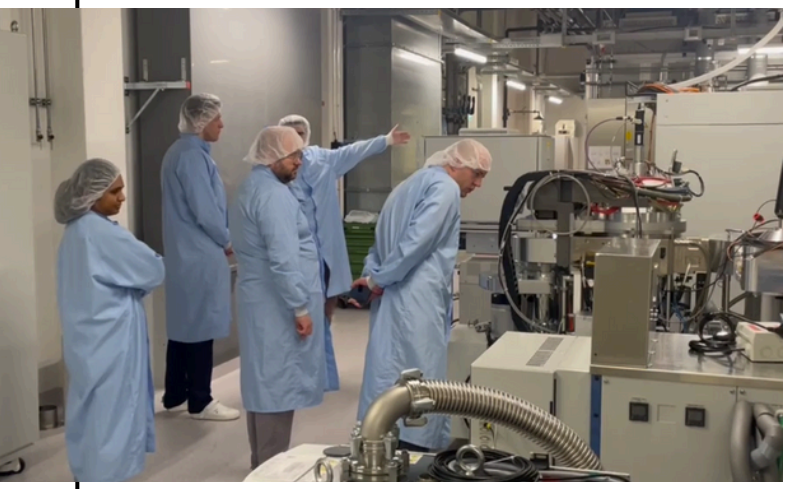
PIONEAR's GA:

Partners met in Buchs, Switzerland, and in Cork, Ireland, for the 4th and 5th General Assembly

The PIONEAR consortium successfully convened for its **4th General Assembly Meeting** from 1-3 April 2025, hosted by the IMP Institute at OST Campus in Buchs, Switzerland. The event brought together all our consortium partners to share progress, discuss challenges, and outline future directions for the ambitious research project.

The assembly began with an Executive Board meeting addressing project management, coordination, and dissemination led by the Coordinator, Per Grön. Discussions included updates on periodic reporting, deliverables, milestones, and risk assessments. Afterwards, accelCH provided an overview of communication and exploitation activities, along with planning and risk evaluation for future efforts.



PIONEAR partners toured OST's advanced laboratory facilities.

The second day focused on technical progress across several work packages, with each session including progress updates and fruitful discussions to address technical challenges and opportunities.

The final day featured a **tour of OST's advanced laboratory facilities**, providing first-hand insight into the institution's research capabilities. Two collaborative discussion sessions facilitated by the Coordinator allowed partners to align their goals and define priorities for the coming months.

PIONEAR's consortium during the 5th GA.

The PIONEAR consortium convened for its **5th General Meeting** from 15–16 October 2025 at the University College Cork (UCC)/ Tyndall National Institute in Cork, Ireland. Hosted by UCC/Tyndall, which provided a stimulating environment for technical exchange, project planning, and networking among consortium members and host-institution researchers. The meeting had sessions on project management,scientific technical work packages, risk assessments, dissemination strategy, and milestones. Day one focused on **detailed technical updates** from the project's Work Package leads and thematic clusters. The second day started with sessions on project coordination and administrative matters.

Attendees were given a guided **tour of Tyndall's advanced laboratories and facilities**, including cleanrooms, photonics testbeds, microfabrication suites, and metrology labs. This enabled us to gain deeper insight into their capabilities and see first-hand how project hardware is being characterised and validated. The tour also fostered informal exchanges and networking among partners.

Tyndall's advanced laboratories and facilities tour.

Interviews:

PIONEAR partners talk about their experience in developing a novel photonic microphone

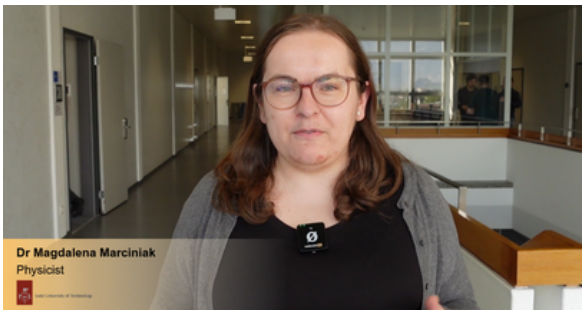
During PIONEAR's 4th General Assembly Meeting from 1-3 April 2025 in Buchs, Switzerland, all consortium partners met to discuss the progress, challenges, and future of the novel photonic microphone technology in development.

Four of the 19 participants shared their responsibilities, perspective and own personal experience in combining acoustics with laser technology and about the precise control of microscale devices:

- Project coordinator **Per Grön**, founder and chief executive officer of Lumiary, emphasized that the high-performance target of the microphone requires three distinct innovations – the acoustic performance of the system, the performance of the sensor and the digitalisation of the signal – all of which are solved by using a novel laser technology.

- **Markus Michler** from the Eastern Switzerland University of Applied Sciences, responsible for the mechanical parts of the microphone, explained how his team is dealing with the placement of the laser, which serves as the sensing element, into the microphone capsule and with providing the interface for sound measurements as they put pressure onto the membrane.

- **Magdalena Marciniak** from the Lodz University of Technology talked about her work with semiconductor lasers, which her team designs and characterizes. The main goal of her photonics group is the design of the laser structure and the characterisation of the device used in the microphone.



- **Kamil Gradkowski** from the Tyndall National Institute has the important role of taking all the elements fabricated by the other consortium members, such as the acoustic chamber, the membrane and the laser, and assemble them inside the microphone capsule, thereby putting all the interfaces into place to have a functional device.

Watch the **video** to hear all insights from our partners!

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Outreach:

Project partner OST presents SLE process for PIONEAR at 126th DGaO Annual Meeting

Team members from the University of Applied Science of Eastern Switzerland (OST) presented their process on selective laser-induced etching (SLE) within the PIONEAR project during the 126th Annual Meeting of the German Society for Applied Optics (DGaO) in Stuttgart, Germany, on Saturday, 14 June 2025.

This yearly event gathers optics specialists from academia and industry to discuss their research results and discuss innovative ideas.

In the PIONEAR project, OST micro-technology and photonics teams collaborate on the membrane, acoustic substrate, and packaging, in coordination with colleagues from Tindall.

Laser-based manufacturing of an acoustic chamber for an optical microphone

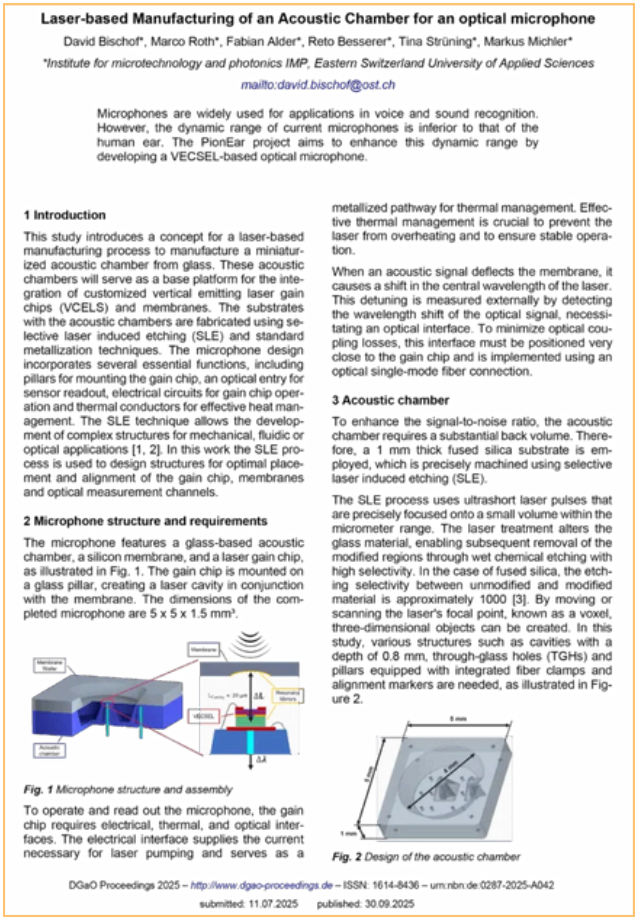
In addition to the talk, titled “Laser-based Manufacturing of an Acoustic Chamber for an optical microphone”, the group from the Institute for microtechnology and photonics (IMP), including David Bischof, Marco Roth, Tina Strüning and Dr. Markus Michler, also submitted an article for the DGaO Proceedings.

This concept study presents a laser-based manufacturing process for creating a miniaturized acoustic chamber made of glass.

These acoustic chambers serve as the foundation for the integration of the customized vertical emitting laser gain chips (VCSELs) and diaphragms for the microphone.

The substrates containing the acoustic chambers are fabricated using SLE and standard metallization processes. The design incorporates several essential functions, including pillar structures for mounting the VCSELs, an optical port for light coupling, electrical conductors for VCSEL control, and thermal conductors for temperature management.

The SLE technique enables the realization of complex structures within the glass substrate, ensuring optimal placement and alignment of the VCSELs, diaphragms, and the optical measurement channel.



Laser-based Manufacturing of an Acoustic Chamber for an optical microphone

David Bischof*, Marco Roth*, Fabian Alder*, Reto Besserer*, Tina Strüning*, Markus Michler*
*Institute for microtechnology and photonics IMP, Eastern Switzerland University of Applied Sciences
mailto:david.bischof@ost.ch

Microphones are widely used for applications in voice and sound recognition. However, the dynamic range of current microphones is inferior to that of the human ear. The PionEar project aims to enhance this dynamic range by developing a VECSEL-based optical microphone.

1 Introduction

This study introduces a concept for a laser-based manufacturing process to manufacture a miniaturized acoustic chamber from glass. These acoustic chambers will serve as a base platform for the integration of customized vertical emitting laser gain chips (VCELS) and membranes. The substrates with the acoustic chambers are fabricated using selective laser induced etching (SLE) and standard metallization techniques. The microphone design incorporates several essential functions, including pillars for mounting the gain chip, an optical entry for sensor readout, electrical circuits for gain chip operation and thermal conductors for effective heat management. The SLE technique allows the development of complex structures for mechanical, fluidic or optical applications [1, 2]. In this work the SLE process is used to design structures for optimal placement and alignment of the gain chip, membranes and optical measurement channels.

2 Microphone structure and requirements

The microphone features a glass-based acoustic chamber, a silicon membrane, and a laser gain chip, as illustrated in Fig. 1. The gain chip is mounted on a glass pillar, creating a laser cavity in conjunction with the membrane. The dimensions of the completed microphone are 5 x 5 x 1.5 mm³.

Fig. 1 Microphone structure and assembly

To operate and read out the microphone, the gain chip requires electrical, thermal, and optical interfaces. The electrical interface supplies the current necessary for laser pumping and serves as a metallized pathway for thermal management. Effective thermal management is crucial to prevent the laser from overheating and to ensure stable operation.

When an acoustic signal deflects the membrane, it causes a shift in the central wavelength of the laser. This detuning is measured externally by detecting the wavelength shift of the optical signal, necessitating an optical interface. To minimize optical coupling losses, this interface must be positioned very close to the gain chip and is implemented using an optical single-mode fiber connection.

3 Acoustic chamber

To enhance the signal-to-noise ratio, the acoustic chamber requires a substantial back volume. Therefore, a 1 mm thick fused silica substrate is employed, which is precisely machined using selective laser induced etching (SLE).

The SLE process uses ultrashort laser pulses that are precisely focused onto a small volume within the micrometer range. The laser treatment alters the glass material, enabling subsequent removal of the modified regions through wet chemical etching with high selectivity. In the case of fused silica, the etching selectivity between unmodified and modified material is approximately 1000 [3]. By moving or scanning the laser's focal point, known as a voxel, three-dimensional objects can be created. In this study, various structures such as cavities with a depth of 0.8 mm, through-glass holes (TGHs) and pillars equipped with integrated fiber clamps and alignment markers are needed, as illustrated in Figure 2.

Fig. 2 Design of the acoustic chamber

DGaO Proceedings 2025 – http://www.dgao-proceedings.de – ISSN: 1614-8436 – urn:nbn:de:0287-2025-A042
submitted: 11.07.2025 published: 30.09.2025

Article for the DGaO Proceedings.

www.pionear-project.eu/news/

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Meet the partners:

The Łukasiewicz – Institute of Microelectronics and Photonics

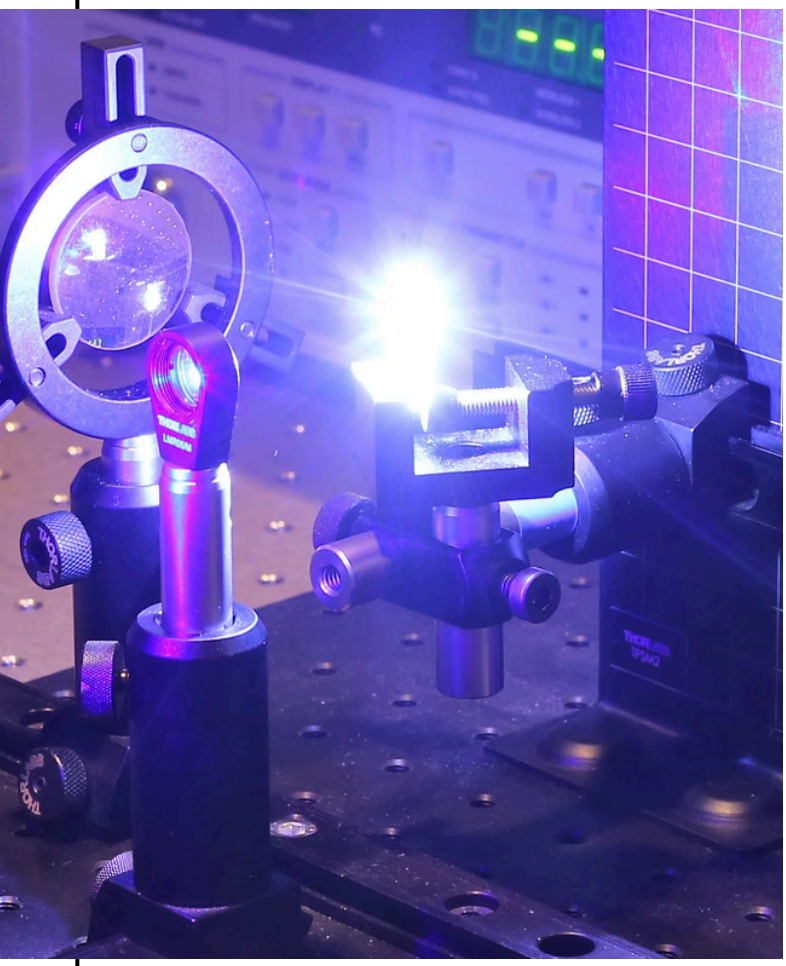

Image from https://imif.lukasiewicz.gov.pl

Driving Innovation in Photonics and Microelectronics

The Łukasiewicz – Institute of Microelectronics and Photonics (L-IMIF), with over 50 years of history, boasts a staff of 420 members.

As part of the Łukasiewicz Research Network, it focuses on developing technologies for new materials such as gallium nitride and graphene, researching their properties, and exploring their applications in various sectors including energy, electronics, photonics, medicine, aviation, defense, space, and automotive industries.

Key photonic technologies include fiber optic and micro-optical technologies, lasers, and radiation detectors.

Notably, as part of the PIONEER Project, the institute is leading the development of VCSEL laser production technology and its integration into the production chain for a new type of microphone.

Meet the L-IMIF team

Marek Ekielski
Leader of 3D Structure Research

Anna Szerling
Director of Nanotechnology Centre

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Meet the partners:

VIGO Photonics

VIGO Photonics is a European manufacturer of epitaxial wafers and instruments for photonics and microelectronics, specialising in MWIR and LWIR detectors and modules, produced with the use of internally-developed technology.

Advanced semiconductor manufacturing and global expansion

VIGO has a complete front-end and back-end production line for semiconductor high-capacity instruments – from epitaxy of II-IV and III-V groups, through detector chips, lasers and their assembly and integration with electronics.

The company is constantly expanding its market reach and now has subsidiaries in Europe and the US.

Currently, VIGO employs approximately 200 employees with specialised knowledge that will enable the implementation of the tasks within PIONEAR.

Image from https://vigophotonics.com/

VCSEL Expertise for Innovative Microphones

Due to the fact that the main goal of the project is to create a proof-of-concept of a novel miniature microphone with better-than-human-ear sound quality, VIGO fits perfectly into the project's ambition.

The vertical-cavity surface-emitting lasers (VCSEL) play a key role in the envisioned device and VIGO is one of the very few companies in Europe that is manufacturing such lasers.

Meet the VIGO team

Walery Kołkowski
Expert of Epitaxy

Justyna Kurek
Epitaxy Engineer

Events:

Upcoming events where PIONEAR partners will participate

SPIE Photonics West 2026

The world's largest optics and photonics technologies event, presenting research in biomedical optics, biophotonics, industrial lasers, optoelectronics, microfabrication, displays, quantum, and emerging vision technologies.

SPIE. PHOTONICS WEST

DATE
Jan 17 - 22 2026

TIME
All Day

LOCATION
Moscone Center
San Francisco, CA, USA

IEEE MEMS 2026

The 39th IEEE International Conference on Micro Electro Mechanical Systems is one of the premier annual events reporting research results on every aspect of MEMS and Microsystems technology, and their relevant technologies and industrial trends.

MEMS2026

DATE
Jan 25 - 29 2026

TIME
All Day

LOCATION
Salzburg Congress
Salzburg, Austria

CLEO Conference 2026

With comprehensive, peer-reviewed technical sessions and market-focused programming, CLEO is the world's premier international forum to learn about innovative advances, research and new technologies from the laser science industry.

CLEO
Laser Science to Photonic Applications

DATE
May 17 - 21 2026

TIME
All Day

LOCATION
Charlotte Convention Center
Charlotte, NC, USA

Laser World of Photonics 2027

The 28th World's Leading Trade Fair with Congress for Photonics Components, Systems and Applications (Laser World of Photonics) will take place from 22-25 June 2027 in Munich, Germany. Laser World of Photonics is the world's leading platform for the laser and photonics industry.

LASER WORLD OF PHOTONICS

DATE
Jun 22 - 25 2027

TIME
All Day

LOCATION
Trade Fair Center Messe München
Munich, Germany

PIONEAR

Developing a photonic microphone with better-than-human-ear sound quality.

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Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Innovation Council and SMEs Executive Agency (EISMEA). Neither the European Union nor the granting authority can be held responsible for them. Project grant number 101129931.

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INTERESTED IN OUR UPDATES?

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