OCTOBER 2021 NEWSLETTER

REDFINCH is an EU H2020 research project aimed at developing Photonic Integrated Circuits (PICs) at mid-infrared wavelengths, in order to realise compact chemical sensors for both gas and liquid. Specific targeted applications within the project include; ***process gas analysis*** *in refineries,* ***gas leak detection*** *in petrochemical plants, and* ***milk protein analysis*** *for the dairy industry.*

REDFINCH adapting to the COVID-19 crisis

Welcome back! As for everyone, it has been an eventful year and a half for the REDFINCH project. All partners were, of course, affected by the lockdowns, in particular those that rely heavily on cleanroom access. Both labs and cleanrooms were completely closed for extended periods, significantly delaying the progress of many project deliverables. However, we are now back up and running, albeit with reduced numbers in labs, strict virus control procedures in place, and much remote working. Following (online) Project Review meetings in July 2020 and July 2021, the project was ***extended to end December 2021****, in order to enable us to complete our original objectives.*

In the meantime, we have not been idle! The project published a number of journal papers, some of which are highlighted below, attended several online conferences, and made a project video. We also welcomed a new project coordinator at CEA-Leti: ***Dr. Nicoleta Pirvanescu*** *took over from Dr. Jean-Guillaume Coutard in Sept 2020. Read on for more.*

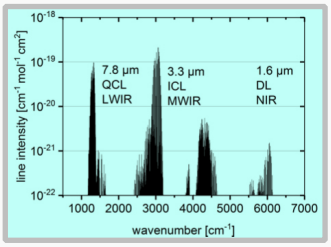
REDFINCH Project Video Released

A promotional video for REDFINCH has been produced, despite some unexpected challenges, thanks to great work by partners at ***Technische Universität Wien****. The original plan for this video was to do much of the filming at a face-to-face meeting to be held in Austria in 2020. Since this meeting had to be held virtually instead, an alternative approach was devised, with most of the filming undertaken at TU-WIEN and combined with footage from other partners. The video explains the need for, and advantage of, the REDFINCH solutions, the technologies involved and the partner contributions.*

It can be viewed on the project homepage at www.redfinch.eu.

Research Highlight: Comparing Photoacoustic and Direct Absorption Spectroscopy

"Comparison of laser-based photoacoustic and optical detection of methane" *- J. Sensors & Sensor Systems, 10, 25-35 (2021)*



REDFINCH activities cover technological advances related to both direct absorption spectroscopy (DAS) and photoacoustic spectroscopy (PAS) - both techniques have advantages and disadvantages depending on the required application. In a recent paper, colleagues at ***Fraunhofer IPM*** *performed a comparison of the two, specifically focusing on their use at three different wavelength regions; near-infrared (NIR), mid-wavelength infrared (MWIR) and long-wavelength (LWIR). This also allowed to compare different semiconductor laser technologies available: diode lasers, interband cascade lasers and quantum cascade lasers. It was shown that, for similar sensing setups for methane, detection limits of <10 ppb for DAS in the MWIR range, and <7 ppb for PAS in the LWIR range can be achieved.*

Read the full paper here: https://dx.doi.org/10.5194/jsss-10-25-2021

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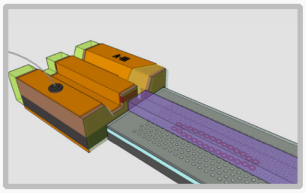
Research Highlight: Invited Review Paper on Photonic Crystal Lasers

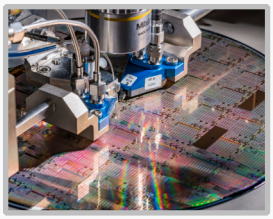
"Photonic crystal lasers: from photonic crystal surface emitting lasers (PCSELs) to hybrid external cavity lasers (HECLs) and topological PhC lasers [Invited]" *- Optical Materials Express, 11, 3245 (2021)*



One of the 'stretch' goals in REDFINCH is exploring the use of hybrid photonic crystal lasers as potential light sources for chemical sensors. The carefully arranged periodic nanostructures known as photonic crystals (PhC), often implemented as an array of holes in a Si layer, have enormous potential as wavelength selective resonators in integrated lasers, with small footprint, high surface area and Q-factor/volume ratios that enable efficient confinement of light. Researchers at partner ***Munster Technological University*** *recently published an invited review paper in Optical Materials Express, describing the main advances in PhC-based lasers, their use in several novel semiconductor laser configurations, and exploring their application in a number of different use cases, from bio-imaging to datacomms. Read the full paper here: https://dx.doi.org/10.1364/OME.430748*

Research Highlight: Volume Fabrication of QCLs on Si

"Volume fabrication of Quantum Cascade Lasers on 200 mm-CMOS pilot line" *- Scientific Reports, 10, 6185 (2020)*



Denis MOREL/CEA

The realisation of high-volume, low-cost fabrication of MIR quantum cascade lasers on Si substrates would be an enormous boost for the uptake of optical chemical sensors such as those developed in REDFINCH. ***CEA-Leti*** *and* ***mirSense*** *have achieved a key step towards this, demonstrating 98% yield per wafer for DFB-QCLs at 7.4 µm implemented on a 200mm CMOS pilot line; the results were published in the Nature journal, Scientific Reports. The top metal grating process used fully respects the design and process rules of a standard CMOS manufacturing line, and achieves performance levels comparable to those of QCLs fabricated on InP substrates. Moreover, the approach allows for automated, wafer-level testing of the devices. The results mark a key milestone towards the realisation of affordable, fully-integrated photonic sensors on a Si chip.*

Read the full paper here: https://dx.doi.org/10.1038/s41598-020-63106-4

Other Recent REDFINCH Publications

- *Dabrowska, A., et al., Optics Express, 28, 36632-36642 (2020)* https://dx.doi.org/10.1364/OE.403981
- *Monge-Bartolome, L., et al., Optics Express, 29, 11268-11276 (2021)* https://dx.doi.org/10.1364/OE.419396
- *Strahl, T., et al., Applied Optics, 60, C68-C75 (2021)* https://dx.doi.org/10.1364/AO.419942
- *Singaravelu, P.K.J.., et al., Crystals, 11, 848 (2021)* https://dx.doi.org/10.3390/cryst11080848
- *Dabrowska, A., et al., Sensors and Actuators: B. Chemical, (pre-print) (2021)* https://dx.doi.org/10.1016/j.snb.2021.130873

New Project Coordinator

Meet our new Project Coordinator at CEA-Leti:

Nicoleta Pirvanescu, Ph.D.
Optical Sensor Devices Group,
Optics & Photonics Department,
CEA-Leti

CIT Becomes Munster Technological University

On 1st January 2021, REDFINCH partner Cork Institute of Technology merged with the neighbouring Institute of Technology Tralee to become Munster Technological University. This marks an exciting new era for MTU!

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