1. Research Challenge

Cardiovascular diseases (CVDs) are the number one cause of death globally, associated with almost 18 million deaths annually [1].



Changes in blood flow can be indicative of abnormalities in the way the heart contracts to pump blood as well as of changes in arterial diameter or elasticity, all harbingers of CVD.







• The EU-funded project 'InSiDe' [2] is developing a handheld laser Doppler vibrometer using silicon photonics and efficient algorithms to deliver real-time signal analysis of selected cardiovascular parameters.

The H2020 'InSiDe' Project Consortium:

Science Foundation Ireland



National Institute

Institiúid Náisiúnta

Integrated Silicon Photonics for Cardiovascular Disease Monitoring

D. Carey¹, P. Morrissey¹, S. Aasmul², P. Záruba³, T. Wotherspoon⁴, G. Schols⁵, Y. Li⁶ and R. Baets⁶ 1 – Tyndall National Institute, University College Cork, Ireland, 2 – Medtronic Bakken Research Centre, Maastricht Netherlands. 3- Argotech, Czech Republic, 4 – Microchip Technology Ltd, Caldicot, Wales, 5 - Fundico, Oostkamp, Belgium, 6 – Photonic Research Group, Ghent University – IMEC, Department of Information Technology, Ghent, Belgium



2. Objectives

Building on previous work from the **H2020 CARDIS project** [3], **InSiDe** is developing a handheld, battery-operated, split diagnostic device, that can be operated as one unit as well as two separate units.



Figure 1: Early Concept of the InSiDe Diagnostic Device

The device is based on a silicon photonics 4-beam laser **Doppler vibrometer (LDV)** comprised of a multi-branch interferometer in each hand piece.



Figure 2: Homodyne Laser Doppler Vibrometer (LDV)





Figure 3: Hybrid Integration of a Laser Diode with a Silicon **Photonics LDV Chip from the H2020 CARDIS Project [3]**









Coherent laser

Mirror

rinity College Dublin Coláiste na Tríonóide, Baile Átha Cliath The University of Dublin

3. Photonic Integration and Packaging

All Designs to be Compatible with Volume Assembly Processes

Glass Lid

Photonic Package

[Silicon Photonics LDV chip with an integrated 1310nm Laser Diode]

Figure 4: InSiDe - Photonic Integration and Packaging Concept



Battery

PCBs and electronics

Figure 5: Core Elements of the InSiDe Diagnostic Device

5. References

- [1] World Health Organisation Cardiovascular Diseases: https://www.who.int/health-topics/cardiovasculardiseases#tab=tab 1
- [2] InSiDe Project Website:
- http://www.inside-h2020.eu/ [3] H2020 CARDIS Project:
 - https://cordis.europa.eu/project/id/644798





reland's European Structural and estment Funds Programmes

Co-funded by the Irish Government and the European Union



4-beam LDV silicon photonics chip. Hybrid-integration of a 1310nm laser diode. Aligned optical beam delivery system.

Photonics assembly

European Union European Structural and Investment Funds