Project Summary

June 2022

NWCAM

North West Centre for Advanced Manufacturing

Causeway Sensors

Causeway™ Sensors

Company overview

Causeway Sensors, based in Belfast, is a spin-out from Queen's University Belfast. Founded in 2015, Causeway develops products that can be plugged directly into bioreactors and bioproduction lines, allowing the capture of quality data in real-time. The technology combines cutting-edge nanotechnology with optical and microfluidic components that can miniaturise laboratory scale processes into a chip.

The projects

- Integration of injection moulded plasmonic nanostructures into a biosensor device
- Plastics for point of care biosensor use

Industry focus

With the goal of bringing its complex high-throughput biosensor instrumentation to market, Causeway Sensors identified the need for research in two areas: the development of a highly sensitive plasmonic functionalised nanostructure sensing platform; and the manufacture of housing and microfluidics.

The objective of the research was to develop a label-free plasmonic biosensor device for use in rapid throughout screening of therapeutic antibodies and drugs. As the biosensor device was to be manufactured in two sections, a key challenge was to bond the sections in such a way as to prevent leakages.

Research partnership

Expertise was required in materials testing, injection moulding, and design and manufacture of housings and microfluidic elements. Causeway was therefore partnered with Ulster University's Advanced Future Materials & Manufacturing group in the School of Engineering at Jordanstown (on the project which focused on developing microfluidic components), and an interdisciplinary biomedical engineering research group in the James Watt School of Engineering at the University of Glasgow (on the project which concentrated on the injection moulding of nanostructure parts).

The project research team included two co-investigators, two research assistants, and one PhD researcher.

Project outputs

Using additive manufacturing, microfluidic components were developed that matched Causeway's sensor surfaces. For example, 3D printing techniques were used to create novel mould materials for subsequent injection moulding of microfluidic parts, and direct 3D printing of microfluidic components was used to develop a unique polymer casing for Causeway's point of care microfluidic diagnostic biosensor device. Upgrading Causeway's biosensor device in this way enables it to be used for more rapid, accurate and economical detection of deadly pathogens in a point of care environment.

The complex process of injection moulding of nanostructure parts resulted in moulds being created by stamping suitable polymers against an e-beam defined silicon master. This process enabled Causeway to screen hundreds of potential nanostructure arrangements for product suitability. This resulted in cost-effective changes being made to the manufacturing process for the nanostructure sensing chip.

Ulster University and University of Glasgow brought extensive knowledge of microfluidics, polymer materials, injection moulding and additive manufacturing to the projects, significantly enhancing Causeway's technical capabilities and skills. The R&D performed through the projects has helped to move Causeway's plasmonic sensor from a development stage of Technology Readiness Level (TRL) 3/4 (Experimental proof of concept/ Technology validated in laboratory) to TRL 5 (Technology validated in relevant environment)[2]; a major achievement for such a complex technological platform. Causeway continues to build on the insights provided by the research projects with the aim of validating the prototype and launching the product by 2025.

Project benefits

- Access to academic R&D expertise and specialist equipment
- Creation of a more competitive value proposition thanks to enhancements in the manufacturing process
- Development of collaborative relationships with a number of major pharmaceutical companies and other supportive networks such as the Centre for Process Innovation (CPI) in Darlington
- Increased competitiveness of the life and health sciences sector through innovation
- Industry-related skills development of academic researchers
- Knowledge dissemination to the wider life and health sciences sector through academic publications and conference presentations
- Progression along the TRL scale (3/4 to 5)
- Reduction of R&D outsourcing costs
- Technology transfer between Ulster University, University of Glasgow and Causeway Sensors
- Upskilling of Causeway Sensors staff with regards to 3D printing techniques, injection moulding of nanostructure parts, and plasmonic studies

Project legacy

Reflecting on the company's involvement in the research projects, Dr Robert Pollard, founder of Causeway Sensors, stated: "We have been delighted with our NWCAM experience. The contribution of the Catalyst team significantly reduced the administrative burden for us and our partners, and the engagement and quality of work from our university partners was highly impressive. The projects with Ulster University and University of Glasgow have enhanced our technical development processes and capabilities; bringing our biosensor instrumentation closer to market."

[2] Héder, M. (2017) 'From NASA to EU: the evolution of the TRL scale in public sector innovation', The Innovation Journal: The Public Sector Innovation Journal, 22(2), p. 11, [Online]. Available at: https://www.innovation.cc/discussion-papers/2017_22_2_3_heder_nasa-to-eu-trl-scale.pdf Accessed 13 June 2022.