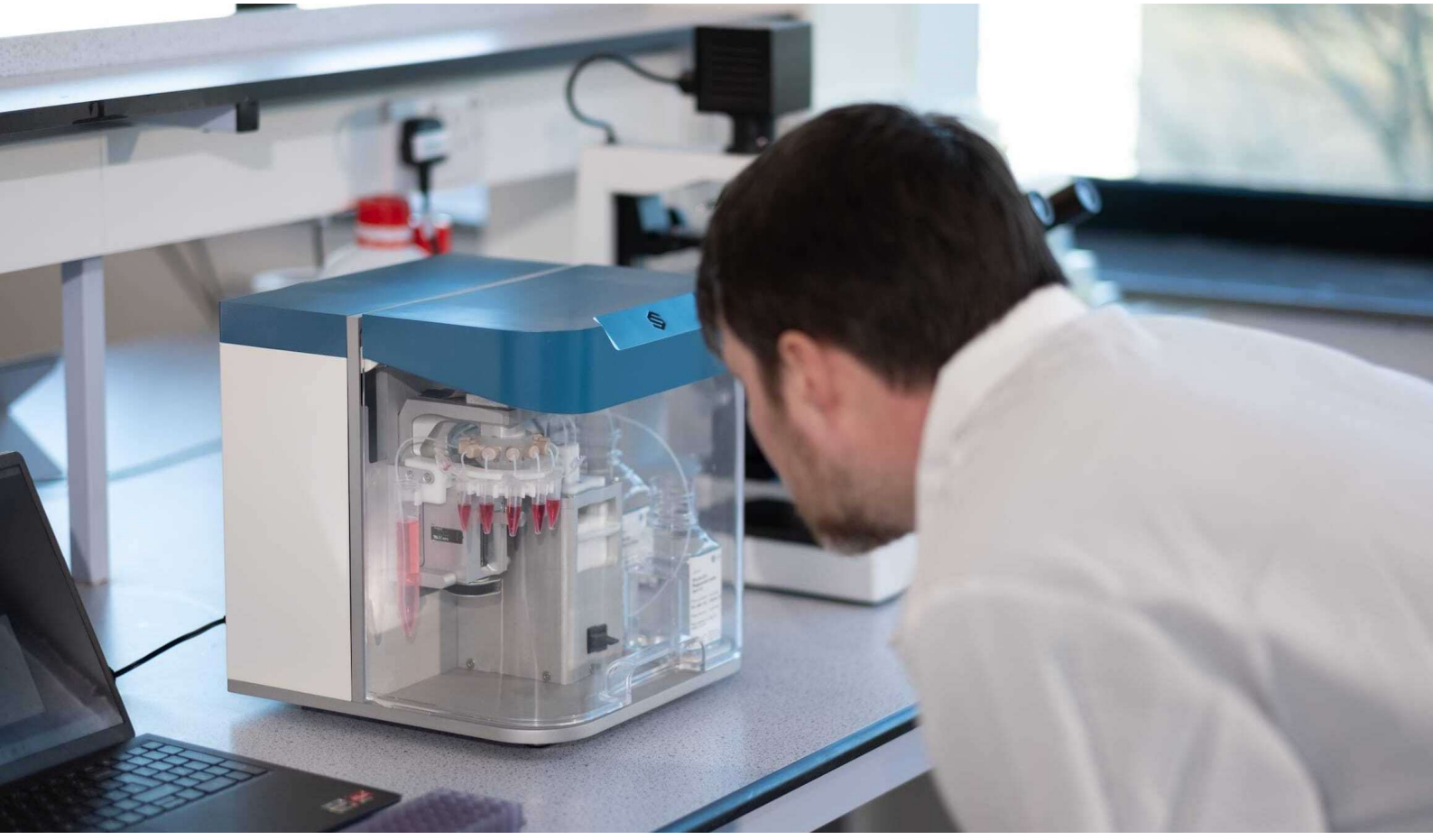
Accelerating in-line PAT innovation to enable smarter biologics manufacturing

Causeway Sensors



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The Challenge

Biologics manufacturers increasingly rely on real-time data to control critical quality attributes and drive more efficient, sustainable processes. Yet most process analytical technologies (PAT) remain off-line or at-line, creating delays that slow decision-making, increase cost, and limit the adoption of continuous biomanufacturing. For SMEs developing novel sensors, validating new technology in an industrial environment can be a major barrier to commercialisation.

Causeway Sensors – a physics-led spin-out from Queen's University Belfast – is addressing this gap with Titan, a next-generation surface plasmon resonance (SPR) platform designed to provide real-time, label-free measurements during antibody production and purification. However, without in-house wet-lab facilities, access to bioreactors, or downstream processing capabilities, the company needed a partner with the necessary infrastructure and expertise to validate Titan in realistic bioprocess conditions.

CPI's collaboration with Causeway Sensors began through two previous projects, where we supported early scoping, prototype testing, and offline validation. Building on this foundation, the current Innovate UK-funded project set out to demonstrate Titan in-line within a continuous downstream purification workflow and explore how real-time data could support smarter, more automated biomanufacturing.

"CPI has been more than a service provider; they have been a true partner, guide, and accelerator on our journey from a lab concept to an industry-ready solution."
Antony Murphy, CEO, Causeway Sensors

How CPI helped

- Produced CHO-K1–derived trastuzumab material to support downstream development and validation.
- Designed and executed initial downstream development studies, including a manual DOE to map the purification design space.
- Integrated the Titan device into CPI's continuous downstream testbed for in-line measurement during purification.
- Developed and validated Titan assays for product quantity and quality, including Protein G and HER2.
- Performed cross-validation of Titan's outputs against CPI's reference analytical systems (HPLC, BLI, Cedex, Nanodrop).

- Provided bioprocessing, analytical, and downstream engineering expertise to de-risk system set-up and validation.

Achievements

- First in-line demonstration of Titan within a continuous downstream monoclonal antibody purification process.
- Successful integration of Titan measurements into an automated downstream experimental workflow.
- New assays for antibody quantity and product-quality attributes validated within a realistic bioprocessing environment.
- Strong analytical correlation demonstrated against industry-standard reference methods.
- Validation data that strengthened Causeway's pathway towards commercial readiness.

Impact

The collaboration with Causeway Sensors represents a significant milestone for PAT innovation in the UK. By validating Titan under real industrial conditions, the project accelerated the platform from an early prototype to a credible, market-ready in-line sensor, helping to unlock opportunities for smarter, more efficient biologics manufacturing. The project also enabled CPI to develop a model based adaptive control system capable of automatically adjusting the chromatography unit operations to achieve optimum results for given process parameters, in this case yield and purity.

For biologics developers, in-line measurements of product quantity and quality create the potential to reduce time-to-result, improve process robustness, and support continuous and automated workflows. This can translate into more consistent biologics, faster development cycles, and greater confidence in critical quality attributes, ultimately supporting more reliable access to life-changing therapies.

For Causeway Sensors, access to CPI's continuous downstream platform, analytical capabilities, and bioprocess expertise substantially reduced development time, technical risk, and the need for costly internal infrastructure. The validation data for the Titan system generated through this collaboration will support strengthening investor confidence, facilitate the development of new product lines, and contribute to the company securing its first commercial contract.

The collaboration also contributes to the UK's strategic biomanufacturing capability, reinforcing national ambitions to strengthen supply chain resilience, support SME-led innovation, and accelerate adoption of continuous, sustainable processes. Embedding PAT within automated downstream workflows can reduce material use, streamline optimisation, and support a more resource-efficient manufacturing future, accelerating life-changing treatments to patients.

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