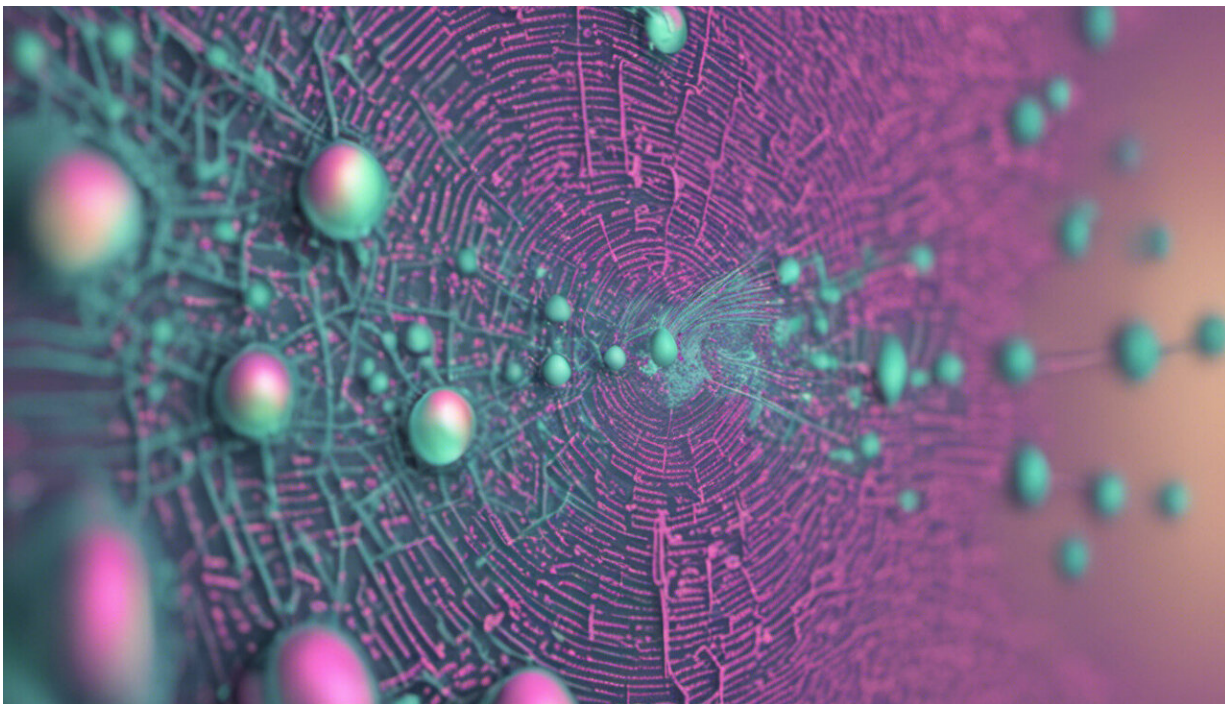


Biosensors for bladder cancer diagnosis

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Credit: AI-generated image ([disclaimer](#))

Cancer constitutes one of the leading causes of mortality worldwide. As early diagnosis is paramount to improved clinical outcome and survival, sensitive diagnostics capable of detecting cancer-related molecules are necessary.

Despite technological advances, traditional methodologies such as ELISA assays are routinely used in clinical practice for diagnosis of

cancer. However, these are time-consuming and suffer from low sensitivity, necessitating alternative clinically relevant solutions for early screening of individuals at high risk of cancer.

Scientists with the EU-funded BlaC E-assay project proposed to develop biosensors, devices broadly used in biomedical applications to detect specific molecules present in biological samples. To detect the target molecule, biosensors employ bioreceptors such as antibodies, oligonucleotides or enzymes that generate a signal such as heat, light or pH change. Via a transducer, the bio-recognition event is converted into an electrical or optical signal that is proportional to the levels of the measured molecule.

Electrochemical biosensors are widely used for at-home monitoring of [blood glucose levels](#) in diabetic patients as well as environmental monitoring, food safety and drug discovery. The idea behind BlaC E-assay was to generate a reliable point-of-care (POC) diagnostic system for cancer that integrated microfluidic and electrochemistry technologies.

A novel biosensor for biomarker detection

Existing electrochemical sensors promise easy operation, accuracy and [high sensitivity](#), but often suffer from issues such as background signals, non-specificity and -selectivity in clinical samples. Since selectivity is the most important feature of a diagnostic [biosensor](#), scientists carefully considered the biorecognition molecules of choice.

"The BlaC E-assay system is a generic platform and can be adapted to a variety of diagnostic tests, as long as there is a biorecognition element available such as an antibody or a DNA aptamer," explains project coordinator Dr. Estrela. "Our efforts concentrated on the detection of multiple protein biomarkers of bladder and breast cancer," he continues.

To overcome the instability of antibodies, scientists looked for alternative bio-recognition elements such as synthetic oligonucleotide aptamers. These come in the form of single-strand DNA or RNA and are designed to bind to specific targets such as proteins.

The BlaC E-assay benchtop device comprises separate assay and detection chambers with innovative surface chemistry and microfluidic design, combined with electrochemical detection techniques. Although, not tested in a clinical environment, commercial blood serum samples spiked with the biomarkers in question showed very promising results.

The BlaC E-assay biosensor was precise and generated reproducible results. Researchers further addressed the sensitivity and resolution of the device. In a clinical setting, biosensors are required to demonstrate high sensitivity of molecule detection at ng/ml concentrations. In addition, they must exhibit sufficient resolution by proportionally responding to analyte levels.

The future of biosensors in disease diagnosis

In spite of extensive research over the past 50 years, commercially available biosensors are extremely limited with the exception of lateral flow pregnancy tests and electrochemical glucose biosensors. Issues with commercial clinical application include difficulties in bringing teams from different disciplines together, translating academic research into commercially viable prototypes and overcoming complex regulatory issues.

With novel nanomaterials and microfabrication technologies, the future of biosensors in biomedical diagnosis certainly looks hopeful. The application niche of disease diagnosis is continuously expanding and advances in biosensor development will undoubtedly aid the diagnosis of many diseases. Following proof-of-principle, Dr. Estrela hopes to obtain

additional funding to construct a device prototype that can be miniaturised and promoted to industry for commercialisation.

Provided by University of Bath

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