STEM RESEARCH HIGHLIGHTS

Sensing & detection examples

Many successful projects have established technical feasibility so translation into clinical practice is possible for wellness monitoring and diagnostic testing. These examples describe methods for sensitive and specific measurement of the concentration or mass of biomarkers in fluids and the properties of cells, along with their potential for the early detection of cancer.

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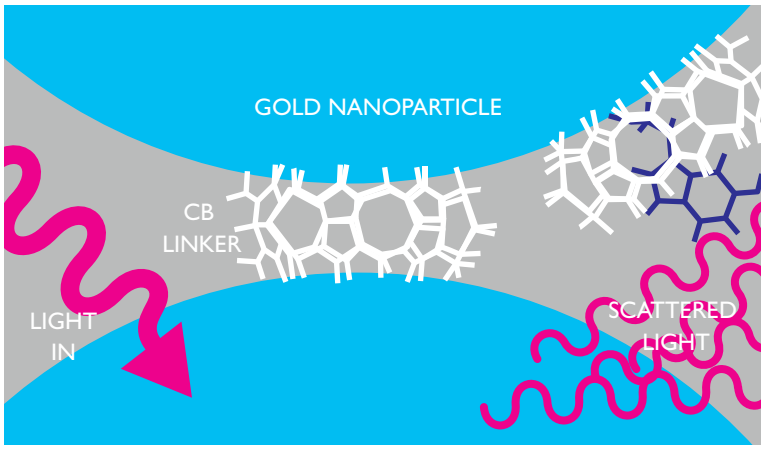
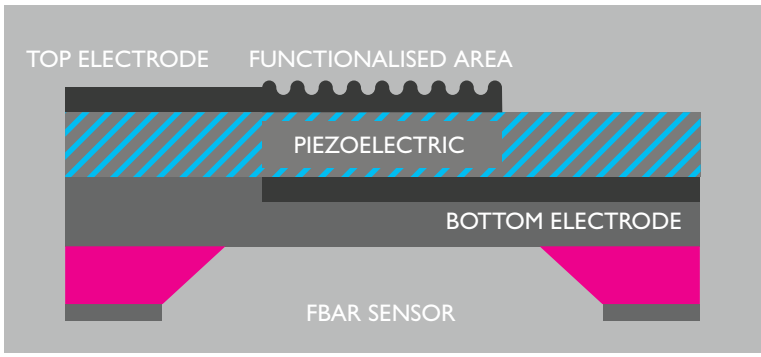
Molecular sensing

Capability - Measures absolute quantities and ratios of multiple biomarkers in a fluid sample.
Clinical potential - Neurotransmitters have been detected in lyophilised human urine; researchers are currently investigating the potential for use in wellness monitoring. The approach shows promise for measuring metabolites, aromatic compounds and hormones and has the potential to work in blood and plasma.
Technology - Gold nanoparticles, cucurbituril (CB) linker molecules and vibrational spectroscopy.
Applications - Point of care testing, Wellness monitoring, Screening.
Relevance for cancer - Could enable detection of biomarkers present at low concentrations in body fluids, i.e. liquid biopsies for screening or surveillance.



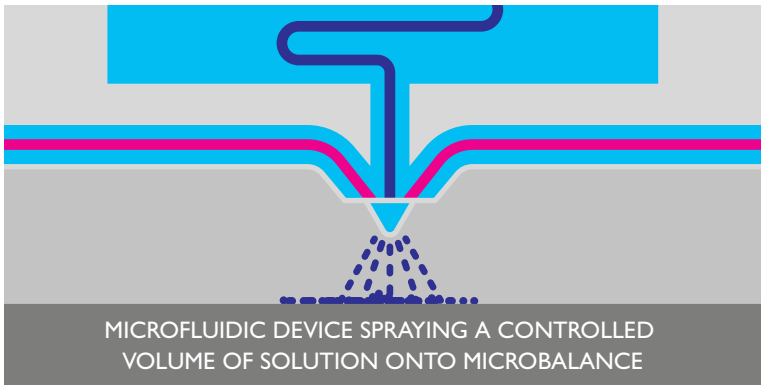
Gravimetric sensing

Capability - Measures mass of multiple biomarkers down to 1 femtogram (~ mass of a virus).
Clinical potential - Feasibility of this technique for the detection of multiple biomarkers in a single body fluid sample is being tested.
Technology - Film bulk acoustic resonator (FBAR).
Applications - Point of care testing, Screening.
Relevance for cancer - Could enable a low-cost protein isoform detection platform, which has the potential to carry out more accurate testing to determine the grade of a prostate cancer in patients with raised prostate specific antigen (PSA).



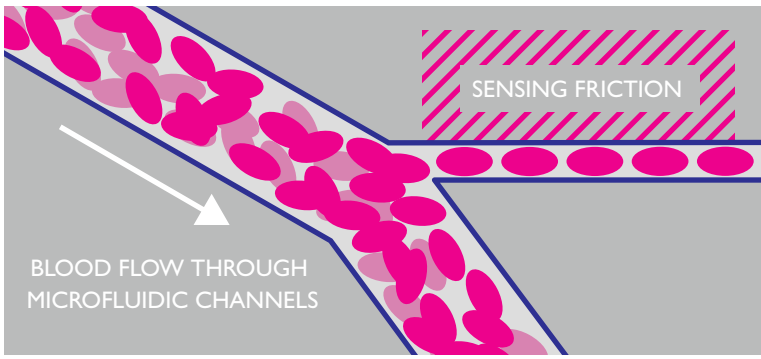
Dry mass sensing

Capability - Accurately measures the mass of a biomarker down to few nanograms (~mass of a cell).
Clinical potential - Provides a label-free approach to developing an understanding of biomolecular interactions in fluids. When a fluid containing a pre-separated biomarker is sprayed onto a surface, it dries almost immediately leaving only the dry mass of the biomarker.
Technology - Microfluidics, micro-resonators (MEMS).
Applications - Point of care testing, Screening.
Relevance for cancer - Could enable highly sensitive detection of biomarkers in body fluids, i.e. liquid biopsies for screening.



Mechanical properties of blood

Capability - Measures mechanical properties of cells in fluid, including stiffness and friction as cells flow past a sensing device.
Clinical potential - Blood cell stiffness and elasticity have been measured as they flow through and deform in the microcirculation. Disease changes cells' mechanical properties - the focus to date has been on elasticity changes induced by sickle-cell anaemia.
Technology - Flow cytometry, microfluidics.
Applications - Point of care testing, Screening.
Relevance for cancer - Cancerous blood cells are mechanically different to normal cells, which could enable leukaemia testing.



To discuss opportunities contact **EDadmin@hermes.cam.ac.uk**