HIGHLY SENSITIVE AND SELECTIVE BIOSENSOR

MATERIALS ANALYSIS AND CHARACTERISATION

System can be used to detect small molecules for the biomedical, food and environment-analysis related industries

Localised surface plasmon resonance (LSPR) for point-of-care (POC) applications is a multi-pronged effort involving A*STAR, universities and hospitals.

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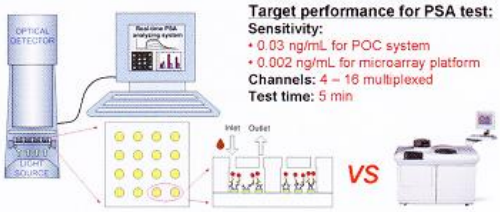
"...will increase the sensitivity of LSPR up to 0.002 ng/mL to meet the requirements for biomedical applications ..."



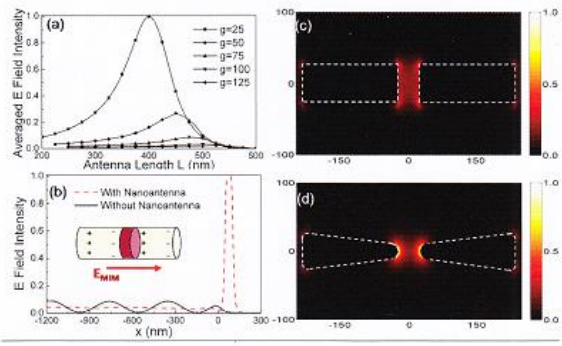
Schematic of the LSPR POC system

INTRODUCTION

Localised surface plasmon resonance (LSPR) is a biosensing technology based on the interaction of noble metal nanoparticles and light. Due to its limited sensitivity and fabrication difficulties, there are currently no LSPR based biosensors in the market. The LSPR biosensors to be developed in IMRE have many advantages over current immunoassay products including its high sensitivity and high selectivity, multiplexing into a microfluidic sensing array, its minimal use of blood sample, its low cost and its quick detection.

BACKGROUND

Current LSPR technology is limited to the laboratory as the sensitivity level of 0.1 ng/mL for protein tests does not meet requirements for medical applications and is not comparable to immunoassay systems in the market. There are also issues with the LSPR microfluidic arrays and difficulties in mass producing the nanostructures needed for LSPR biosensors.



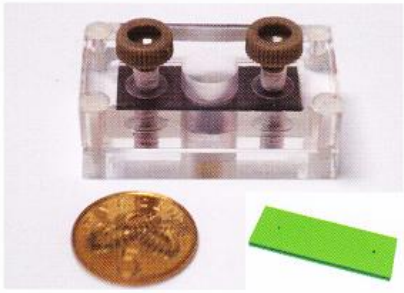
*A*STAR IHPC's plasmonic simulation*

INNOVATION AND ACHIEVEMENT

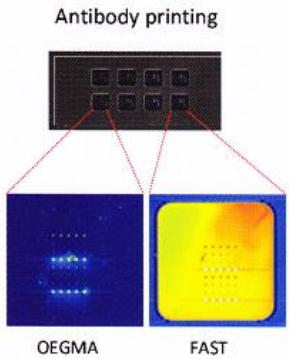
IMRE, in a multi-pronged approach with several groups, is developing an LSPR sensing platform and its POC system using a prostate-specific antigen (PSA) biomarker for detecting prostate cancer, as a demonstrator. IMRE is looking to improve the LSPR technology by adding secondary antibodies with fluorescence or nanoparticle tags to amplify the LSPR signals and increase the LSPR sensitivity up to 50 times. We target the PSA sensitivity for the LSPR sensing platform to reach 0.002 ng/mL, and for the POC system to reach 0.03 ng/mL. These specifications are equivalent to or exceed the best immunoassay and POC systems for PSA tests in the market. A non-fouling polymer will also be synthesised with NTU to potentially improve the detection selectivity about 100 times. NTU will also fabricate the nanostructures and the POC system. Using A*STAR's IHPC plasmonic simulation, the metal nanostructures will be optimised for high signal-to-noise ratio LSPR detection. A*STAR's SIMTech will mass fabricate the disposable LSPR microfluidic sensing arrays. Singapore General Hospital (SGH) will provide patients' blood samples and validate the developed biosensor.

IMPACT

The research team will increase the sensitivity of LSPR up to 0.002 ng/mL to meet the requirements for biomedical applications. Mass fabrication of identical gold nanostructures on a large glass area and of the LSPR microfluidic arrays will also be achieved. Compared with commercially available bulky immunoassay systems, the technology to be developed in this project is expected to have higher sensitivity, minimised blood sampling, multi-biomarker detection, reduced cost, and a faster readout. Our goal is to develop a highly sensitive and highly selective LSPR sensor array platform and its point-of-care (POC) system to detect small molecules for use in the biomedical, food and environment-analysis related industries. Such a system is important in clinical diagnosis and screening as well as in monitoring of infectious disease outbreaks, in the battlefield, and even in the home.



LSPR microelectromechanical system developed in IMRE



Non-fouling polymer for increasing selectivity developed by NTU

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