

## **Biosensor and microfluidic chip based Point-of-care systems for disease diagnosis**

Biosensor and microfluidic chip based point-of-care (POC) testing offers many advantages over centralized laboratory testing, such as small sample and reagent volumes required, rapid detection and on-site analysis. In Temasek Polytechnic Microelectronics Center, we are focusing on developing biosensor and microfluidic chip based POC systems for immunological detection of diseases, such as Sepsis and Urinary Tract Infection (UTI). The systems integrate several elements: (1) biosensor, (2) microfluidic chip, (3) pumps and valves for fluid delivery, (4) signal detection components, and (5) a computer for controlling the fluidics, logging and data analysis.

A POC system for quantitative analysis of procalcitonin (PCT) was developed based on a plasmonic biosensing chip. The plasmonic biosensing chip with gold nanopillar array structure was fabricated by high fidelity nanoimprinting technology. The chip was integrated into a microfluidic device to channel reagents over the nanopillar array. A robust sandwich bioassay of capture antibody / PCT / detection antibody labelled with quantum dot (QD) was established on the chip. To detect the QD emission from the chip, a CCD-based fluorescence detection system was built, which uses a laser beam as light source and an air-cooled CCD camera as detector. A compact circular multi-purpose holder for receiving the microfluidic device was designed with reduced tubing length and optimized valves and reservoirs configuration. With incorporation of the control cum switching software program, this POC system is user friendly and provides a desirable on-site yet sensitive detection of PCT at 1ng/ml for clinical practice. Another POC system integrated with dielectrophoresis on-chip concentration module was developed for UTI detection. A sandwiched immunoassay was developed on microfabricated interdigitated electrode (IDE) biosensor chip for UTI *E.Coli* detection. Dielectrophoresis (DEP) technology was successfully used to concentration *E.Coli* and increased the local concentration of bacteria for more than 1000 folds. The DEP-enhanced microfluidic immunoassay can detect *E.Coli* at the concentration level of  $10^5$  CFU/ml.