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Clinical demand of improving immunological diagnostics through the application of biosensors and bioelectronics

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The rapid diagnosis of infectious diseases is critical for timely initiation of treatment and important for optimal clinical outcomes[1]. In this background, the use of point-of-care testing (POCT) is growing rapidly. Nevertheless, the performance of the serological POCT kits is much lower than that of automated systems for central laboratories. This limits the broad utilization of POCT[2], and thus clinical demands on improving its performance increase continuously.

Biosensor is an analytical device, used for the detection of an analyte, that combines a biological component with a physicochemical detector.

Recent advances in nanotechnologies and microfluidics have led to development of biosensors and bioelectronics improving immunological diagnostics[1]. Biosensors offer the possibility of an easy-to-use, sensitive and inexpensive technology platform to quickly identify pathogens and select effective treatment. Biosensor-based immunoassays may improve the detection sensitivity of targets, while multiplex detection of host immune response antibodies (serology) may improve the overall specificity[1].

In addition, several advantages of biosensors include easy to use, small reaction volume (less reagent and lower cost), short running time, high portability, multiplexing ability[3]
In this session, we introduce the newly advanced techniques in biosensors and bioelectronics focused on clinical application.

Furthermore, fully integrated systems that bring together the components of sample preparation and analyte detection remain a critical challenge for biosensor technology[4, 5]. One of critical steps is microfluidic sample preparation including concentration, mixing and separation. A full automated lab-on-a-disc format using centrifugal microfluidics has been developed for sandwich type immunoassay[6]. Compared to the conventional blood analysis done in clinical laboratories, it is advantageous for point-of-care applications because it requires a smaller amount of blood (350 μL vs. 3 mL), takes less time (22 min vs. several days), does not require specially trained operators or expensive instruments to run[7].

However, even the most promising sensors need to be clinically validated with the clinical samples according to performance evaluation guidelines. Moving forward, more comprehensive collaboration among academies, healthcare units and industries is the key for the realization of the real lab-on-a-chip devices[1].

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