Development of Point-of-Care Programmable Diagnostic Tools

There is a clinical need for robust, rapid, point-of-care serologic assays for the detection of infectious diseases and cancer. This project leverages two existing and complementary technologies towards the development of a cost-efficient, robust and analytically flexible point-of-care device for serologic measurements of any target antigen viz. centrifugal microfluidic technology and programmable immunoassays.

The Ducree Lab at DCU established a centrifugal microfluidic platform for a wide range of applications, with technologies that allow an unprecedented level of process integration, programmability and automation encompassing on-board reagent management, sample preparation and detection. The Anderson Lab at ASU has established platforms for the rapid and flexible expression of target proteins for clinical immunoassays. The system is flexible for serologic (Ig) measurements to any antigen which can be expressed from cDNA (i.e. HIV, hepatitis, cancer proteins, etc.), only by switching the DNA used (no change in the microfluidic design or materials required).

Full automation of an Enzyme-Linked Immuno-Sorbent Assay (ELISA) for the detection of antibodies in whole blood has recently been demonstrated.* On this "Lab-on-a-Disc" (LoaD) platform, all unit operations were implemented by event-triggered rotational flow control. In order to avoid interference during absorbance measurement from the solid phase in this heterogeneous assay format, it is pivotal that the intermediate reaction product is eventually forwarded from the incubation chamber to a distinct optical measurement chamber.

By combining the programmable serological assay with the innovative event-triggered Lab-on-a-Disc, the researchers have created a unique and accurate laboratory device has been created that requires little user intervention, making it ideal for point-of-care healthcare delivery.

* Mishra, R. et al. Lipophilic-Membrane Based Routing for Centrifugal Automation of Heterogeneous Immunoassays. Proc. 28th Int. Conf. MicroElectro Mech. Syst. 2015, 3–6.

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