Development of Microfluidic-Based Point-of-Care Diagnostic Systems

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Our laboratory focuses improving healthcare in the developed and developing world through the design of microfluidic systems to be used in simple portable devices for point-of-care assays of biological fluids. One aim is to develop quantitative immunoassays that could be run more inexpensively, more frequently, and at the point of care. We have recently developed a series of microfluidic devices that allow a unique set of chemical analysis to be performed both rapidly and in a format that lends itself to inexpensive mass production. These rely on the low Reynolds number conditions present in microchannels. There are some surprising fluidic phenomena specific to microdevices that can be used very effectively to enhance detection of analytes. One project in our lab is aimed at developing inexpensive diagnostic instruments for salivary analytes based on surface plasmon resonance imaging—a technique that allows quantitation of molecules bound to a surface based on changes in the local refractive index. We have developed a simplified imaging system and coupled it to a novel microfluidic immunoassay that is highly parallelizable. By using dry reagent storage on polymeric disposables, the per-test costs can be very low. The system has been extensively modeled using computational fluid dynamics, tested for rapid immunoassays of multiple small molecules from whole saliva.