Paper/Polymer Hybrid Microfluidic Devices for Point-of-care Bioanalysis

Prof. XiuJun (James) Li
Department of Chemistry and Biochemistry
University of Texas at El Paso (UTEP)

Abstract:

There is a great need for simple, affordable disease biomarker detection methods in low-resource settings without the aid of costly and bulky instruments. Although numerous polydimethylsiloxane (PDMS) and paper-based microfluidic devices have been developed to address this issue, PDMS/paper hybrid systems that take advantage of both substrates are rarely reported. Herein, I will highlight several low-cost paper/polymer hybrid microfluidic systems developed by my group for rapid and sensitive disease diagnosis, especially in low-resource settings. For instance, paper was used in a PDMS/paper hybrid microfluidic system integrated with loop-mediated DNA isothermal amplification (LAMP) for rapid and sensitive multiplexed infectious disease diagnosis, including meningitis (a global disease with high morbidity and mortality) and pertussis. The introduction of paper into the microfluidic device enables stable test results over a much longer period of time than a paper-free microfluidic system. Results can be observed by the naked eye. Although this hybrid system does not require expensive instruments, its sensitivity is even higher than conventional real-time PCR. Additionally, we have also developed a paper/PMMA hybrid microfluidic immunosensing microplate for hepatitis B diagnosis. The unique funnel-shaped microwell design enabled rapid antigen immobilization and efficient washing. Without any specialized equipment, the limit of detection of 1.60 ng/mL hepatitis B surface antigen was achieved within one hour, which is comparable to commercial kits using spectrophotometers.

Biography:

XiuJun (James) Li, Ph.D., is Professor with early tenure in the Department of Chemistry and Biochemistry, Biomedical Engineering, and Environmental Science & Engineering at the University of Texas at El Paso (UTEP), USA. He is also the Director of Forensic Science Program at UTEP. After he obtained his Ph.D. degree in microfluidic lab-on-a-chip bioanalysis from Simon Fraser University (SFU) in Canada in 2008, he pursued his postdoctoral research with Prof. Richard Mathies at University of California - Berkeley and Prof. George Whitesides at Harvard University, while holding a Postdoctoral Fellowship from Natural Sciences and Engineering Research Council (NSERC) of Canada. Dr. Li's current research interest is centered on the development of innovative microfluidic lab-on-a-chip and nanotechnology for bioanalysis, biomaterial, biomedical engineering, and environmental applications, including but not limited to low-cost diagnosis, pathogen detection, nano-biosensing, genetic analysis, 3D cell culture, tissue

engineering, and single-cell analysis, with funding support (~$7M in total) from multiple funding agencies including NIH, NSF, CPRIT, DOT, UT System and so on. His lab has extensive experience in point-of-care detection. He pioneered the novel concept of paper/polymer hybrid microfluidic devices. He, for the first time, developed photothermal biosensors for low-cost quantitative analysis using a common thermometer.

He has coauthored more than 110 publications (such as *Adv Drug Deliv Rev*, *Appl Catal B-Environ*, *Chem Sci*, *Anal Chem*, *Biosens Bioelectron*) and 22 patents, including three books from Elsevier on microfluidic devices for biomedical applications. He is an Advisory Board member of *Lab on a Chip* and *Analyst*, the Founder of microBioChip Diagnostics LLC (μBCD), and an editor of 6 journals including *Scientific Reports* from the Nature publishing group, *Micromachines*, etc. He is the recipient of the "Bioanalysis New Investigator Award" in 2014, UT STARS Award in 2012, NSERC Postdoctoral Fellow Award in 2009, Chinese Government Award for Outstanding Self-financed Graduate Student Abroad (2004), Outstanding Faculty Dissertation Research Mentoring Award (twice), and so on. For more information, please visit http://li.utep.edu.