Printing the Next Generation of Point-of-Care Diagnostic Tests

Elain Fu, Barry Lutz and Paul Yager

Abstract

Two-dimensional paper networks (2DPNs) area new set of devices allow complex chemical processing in a very low-cost format. We have, for the last 5 years, been learning how to translate what we have learned about point-of-care diagnostic technologies in conventional microfluidics into the language of porous media. The wicking of fluids in porous materials (like paper, nitrocellulose membranes, etc.) allows us to discard pumps, which permits great savings in complexity and cost, and the potential to perform complex tests without any permanent instruments. However, there are many physical and chemical differences between open ducts and porous media. We have put a good deal of effort into understanding the performance and design rules of simple paper systems. Furthermore, application of reagents to the papers in liquid and dry form is central to device development, testing, and economical manufacture. Currently, the primary applications for this technology in our lab are highly-sensitive multiplexed immunoassays and multiplexed isothermal nucleic acid amplification assays. All assays are designed with visible optical readout that can be captured and quantified using camera-equipped cellular phones.

Biography

Paul Yager, a native of Manhattan, received his A.B. in Biochemistry from Princeton in 1975, and a Ph.D. in Chemistry from the University of Oregon in 1980. He specialized in vibrational spectroscopy of biomolecules, particularly phospholipids. He was an NRC Fellow at the Naval Research Laboratory in DC from 1980 to 1982, joining the NRL staff in 1982. There he focused on self-assembly of lipid microstructures and development of biosensors. He joined the Department of Bioengineering at the University of Washington in 1987 as Associate Professor. He was promoted to Professor in 1995, becoming Vice Chair in 2001, Acting Chair in 2007 and Chair from 2008 to 2013. He currently holds Adjunct faculty position in Chemistry, Oral Biology and Global Health. Since 1992, research in the Yager lab has focused on development of microfluidic devices for monitoring of medically significant analytes in biofluids under support from NSF, NIH, DARPA, The Whitaker Foundation, the government of Singapore, and private companies. Support from Senmed Medical Ventures and DARPA resulted in the creation, in 1996, of Micronics, Inc., in Redmond. The primary goal of current work in his laboratory is decentralization of biomedical diagnostic testing in the developed and developing worlds, and increasing access to healthcare. In 2005 Yager was awarded a grant from the Bill & Melinda Gates Foundation under their Grand Challenges in Global Health initiative; the DxBox project developed a low-cost rugged point-of-care platform based on microfluidics for diagnosing diseases in the developing world. Since 2008, the lab has had a growing focus on development of instrument-free medical diagnostics based on low-cost 2-dimensional paper networks Current support is from NIH and DARPA. Specifics can be found at http://faculty.washington.edu/yagerp/.