Small scale, large potential: An expert weighs in on the future of microfluidics

March 14 2014, by John Steeno

(Phys.org) —More than a decade ago, David Beebe wrote that the field of microfluidics had the potential to significantly change modern biology. Now Beebe, an expert in the field, has written a high-level perspective on the state of microfluidics for the journal *Nature*.

Tiny self-contained laboratories that easily can fit in the palm of a researcher's hand, microfluidic systems enable scientists to study the behavior of fluids on the microscale.

Beebe's paper, "The present and future role of microfluidics in biomedical research," was published in the March 13 issue. Beebe, a University of Wisconsin-Madison professor of biomedical engineering, co-authored the paper with Anna Fulton and his former student, Eric Sackmann.

For Beebe, who holds more than 30 patents in microfluidics technologies alone, this technology is the basis of his research. He has used his expertise in microscale fluid dynamics for innovations in everything from point-of-care diagnostics (streamlining methods for preparing patient samples such as blood and urine in developing countries) to cancer research (by emulating breast cancer growth in the hope of finding new treatment methods).

The versatility of microfluidic technologies can allow researchers in various fields to take advantage of these systems. Despite the advantages, Beebe says biologists' adoption of microfluidic technologies has been slower than he anticipated over the past decade. "The slow pace of adoption has been frustrating," he says, "because of the potential for microfluidics to advance basic science and diagnostics."

Finding specific applications for microfluidic technologies that either improve upon the cost or the speed of current systems can quicken the pace of adoption. Using low-cost, destructible materials such as paper or wax, microfluidic methods can be used to perform a variety of low-cost diagnostic tests, such as diagnosing human immunodeficiency virus (HIV). Microfluidic methods have also been used to rapidly speed processing times in the analysis of neutrophils from roughly an hour using conventional techniques to a few minutes using only microliters of blood.

In the *Nature* perspective, Beebe also says "organ-on-a-chip" technologies could be an answer to the high cost of pharmaceutical research and development. Replicating organ functions on a microchip, the technology could mimic particular organs both in normal and diseased states and allow researchers to test the efficacy of various drugs.

Organ-on-a-chip technologies are under development and, says Beebe, wider adoption of microfluidics overall will happen one application at a time. The next application likely will arise from a greater collaboration between engineers and biologists. "The more engineers communicate with the end user and the more they understand the route to adoption," he says, "the more the path can be shortened."

More information: "The present and future role of microfluidics in biomedical research." Eric K. Sackmann, Anna L. Fulton, David J. Beebe *Nature* 507, 181–189 (13 March 2014) DOI: 10.1038/nature13118. Received 02 August 2013 Accepted 31 January 2014. Published online 12 March 2014

Provided by University of Wisconsin-Madison