Chemically generated convective transport in microfluidic system

OLEG SHKLYAEV, Department of Chemical Engineering, The University of Pittsburgh, SAMBEETA DAS, ALICIA ALTEMOSE, Department of Chemistry, The Pennsylvania State University, HENRY SHUM, ANNA BALAZS, Department of Chemical Engineering, The University of Pittsburgh, AYUSMAN SEN, Department of Chemistry, The Pennsylvania State University — High precision manipulation of small volumes of fluid, containing suspended micron sized objects like cells, viruses, and large molecules, is one of the main goals in designing modern lab-on-a-chip devices which can find a variety of chemical and biological applications. To transport the cargo toward sensing elements, typical microfluidic devices often use pressure driven flows. Here, we propose to use enzymatic chemical reactions which decompose reagent into less dense products and generate flows that can transport particles. Density variations that lead to flow in the assigned direction are created between the place where reagent is fed into the solution and the location where it is decomposed by enzymes attached to the surface of the microchannel. When the reagent is depleted, the fluid motion stops and particles sediment to the bottom. We demonstrate how the choice of chemicals, leading to specific reaction rates, can affect the transport properties. In particular, we show that the intensity of the fluid flow, the final location of cargo, and the time for cargo delivery are controlled by the amount and type of reagent in the system.

Oleg Shklyaev
Department of Chemical Engineering, The University of Pittsburgh

Date submitted: 06 Nov 2015   Electronic form version 1.4