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Manipulating Microvolumes of Fluids in Different Paths By Magnetohydrodynamics

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Abstract

Magnetohydrodynamics (MHD) is a unique approach for pumping fluids on a microscale and is highly suitable for enabling multiple functions for chemical analysis on a chip. An ionic current, **j**, is established in the fluid between selectively-activated electrodes in the presence of a magnetic field, **B**, that is perpendicular to the current, to generate a force, $\mathbf{F}_B$, orthogonal to **j** and **B**, through the right hand rule. $\mathbf{F}_B$ is a body force that propels the liquid in the same direction through momentum transfer. We use microelectrodes, which are patterned into different, individually-addressable geometries on chips. Those electrodes are modified with poly(3,4-ethylenedioxythiophene), PEDOT, a conducting polymer, that converts the applied electronic current in the external circuit to ionic current in the fluid [1]. A small NdFeB permanent magnet is placed under the chip to provide **B**. By strategic activation of the electrodes, fluid flow can be programmable. For example, we previously demonstrated that MHD can start, stop, reverse, adjust speed, and alter profiles of the fluid flow. We have also shown recently that MHD fluid flow can be diverted in a contactless way by magnetic field gradients when paramagnetic species are present [2]. In our presentation, we will discuss how MHD can control the paths of individual microvolumes of different fluids for mixing, sampling, and injection. We will describe the conditions that lead to and the resulting flow profiles that result from adjacent counter flows, transverse paths, and different solvent compositions.

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References

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