On the Modeling and Simulation of Electroosmotic Micropump for Biomedical Applications

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Abstract

Non-mechanical micropumps, which does not required moving parts, have prominent role in several biomedical microsystems such as drug delivery, and lab on a chip. Electroosmotic micropump is a non-mechanical micropump that is used to move electrically neutral fluids through very small cross section channels. Given that, the channel walls must have attached immobile charges. As shown in Figure 1, a glass wall that is coated with ionizable materials will produce these immobile charges. Since the concentration gradient of the electric charges decreases toward the center of channel, a dual layer of fluid is formed with varying concentration of charges as shown in Figure 1. By applying an electric field, the cations will move from the cathode towards the anode. The momentum of these moving charges will drag the fluid to move also from the cathode to the anode as shown in Figure 1.

In this paper, modeling and simulation of electroosmotic micropump using non-Newtonian fluid like blood will be conducted to investigate its' performance. The simulation will be done using COMSOL Multiphysics® software. A 2D model is used for one pumping stage to examine the pumping pressure and flow rate of blood using electro-osmotic micropump. The results of the one stage can be extended to multi-stage micropump. This simulation will involve several physics such as laminar flow, transport of diluted species and electric currents. A two-step study, stationary and time dependent, will be performed. The expected results in terms of pressure and fluid flow of the micropump for a several electric fields are important to assess the suitability of using electro-osmotic micropump for biomedical applications, which involve blood such as lab on chips.

Figures used in the abstract

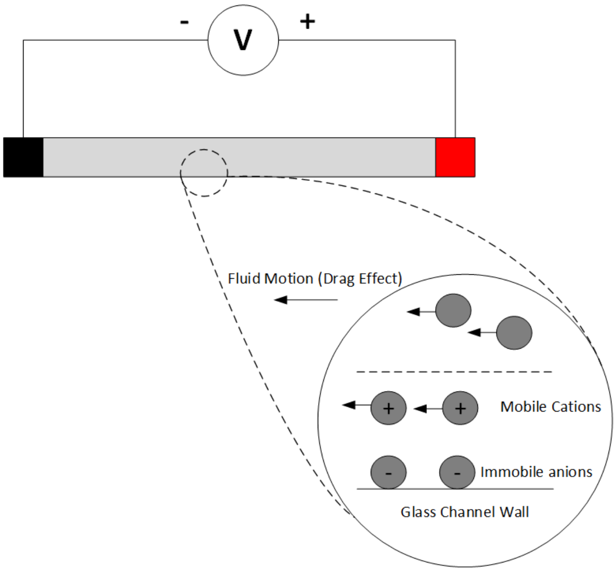

Figure 1: Schematic of the system.