Advanced Science Letters, vol. 19(1), 2013, pages 12-15

The electroosmosis mechanism for fluid delivery in PDMS multi-layer microchannel

Abstract

Here we reported on fabrication of multi-layer microstructures that takes the advantage of electroosmosisto mix fluids. Microlaboratories for biochemical applications often require rapid mixing of different fluid streams. At the microscale, flow is usually highly ordered laminar flow and the lack of turbulence makes diffusion the primary mechanism for mixing. While diffusional mixing of small molecules can occur in a matter of seconds over distances of tens of micrometers, mixing of larger molecules such as peptides, proteins, and high molecular- weight nucleic acids can require equilibration times from minutes to hours over comparable distances. Such delays are impractically long for many chemical analyses. These problems have led to an intense search for more efficient mixers for microfluidic systems most microscale mixing devices are either passive mixers that use geometrical stirring or active mixers that use moving parts or external forces, such as pressure or electric field. In a passive mixer, one way of increasing the mixing is by "shredding" two or several fluids into very thin alternating layers, which decreases the average diffusion length for the molecules between the different fluids. Another way of improving mixing efficiency is to use active mixers with moving parts that stir the fluids. At the microscale level moving parts in an active mixer are very fragile. One alternative solution which we explored is to use electroosmotic effects to achieve a mixing effect that is perpendicular to the main direction of the flow.

Keywords

Diffusion; Electroosmosis; Microfluidic; Microlaboratories; Multi-layer microstructure