Influence of polymer structure on electroosmotic flow and separation efficiency in successive multiple ionic layer coatings for microchip electrophoresis

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Abstract: The effect of successive multiple ionic layer (SMIL) coatings on the velocity and direction of EOF and the separation efficiency for PDMS electrophoresis microchips was studied using different polymer structures and deposition conditions. To date, the majority of SMIL studies have used traditional CE and fused-silica capillaries. EOF was measured as a function of polymer structure and number of layers, in one case using the same anionic polymer and varying the cationic polymer and in the second case using the same cationic polymer and varying the anionic polymer. In both situations, the EOF direction reversed with each additional deposited polymer layer. The absolute EOF magnitude, however, did not vary significantly with layer number or polymer structure. Next, different coatings were used to compare separation efficiencies on native and SMIL-coated PDMS microchips. For native PDMS microchips, the average separation efficiency was 4105 +/- 1540 theoretical plates. The addition of two layers of polymer increased the separation efficiency anywhere from two- to five-fold, depending on the polymer structure. A maximum separation efficiency of 12 880 +/- 1050 theoretical plates was achieved for SMIL coatings of polybrene (cationic) and dextran sulfate (anionic) polymers after deposition of six total layers. It was also noted that coating improved run-to-run consistency of the peaks as noted by a reduction of the RSD of the EOF and separation efficiency. This study shows that the use of polyelectrolyte coatings, irrespective of the polymer structure, generates a consistent EOF in the current experiments and dramatically improves the separation efficiency when compared to unmodified PDMS microchips.

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