Microfluidic Study of Electrophoresis-On-a-Chip in μTAS for Protein Analysis: Effect of Buffer Solution Environments

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Microfluidic understanding is an important issue in charge characteristics of proteins for proteomics. Microchip electrophoresis technique has been used for μTAS. The main thrust of this research is to assess a consistent framework based on electrokinetic principles with attention to rigorous interpretation of experimental data. Instead of Debye-Hückel ansatz, we developed a computational model that would allow the precise analysis of both zeta potential and net charge by taking advantage of Henry's formula on the basis of nonlinear Poisson-Boltzmann equation. Experimental results of mobility data were obtained for both bovine serum albumin and ovalbumin in different pH and ionic strength of buffer solution. More accurate value of the net charge was evaluated from the corresponding relationships between potential distribution and surface charge. Results by linear correlations are identified to overestimate the zeta potential, while they underestimate the net charge. The discrepancy between linear and nonlinear correlations increases with increasing the absolute value of zeta potential, implying a necessity of the full analysis of nonlinear electric field.