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Charged solute transport and separation in nanochannels with surface roughness GUOQING HU, Laboratory of Nonlinear Mechanics, Institute of Mechanics, CAS, Beijing 100190 — Newfound attention has been given to solute transport in nanochannels. Because the electric double layer thickness is comparable to characteristic channel dimensions, nanochannels have been used to separate ionic species with a constant charge-to-size ratio (i.e., electrophoretic mobility) that otherwise cannot be separated in electroosmotic or pressure-driven flow along microchannels. Surface roughness is usually inevitable during the fabrication of nanochannels. We develop a numerical model to investigate the transport and separation of charged solutes in nanochannels with hundreds of roughness elements. The solute transport patterns in rough channels are compared with those in smooth channels. The effects of surface roughness on the migration speed and retention (defined as the ratio of the solute speed to the fluid speed, used to characterize the efficiency of solute separation) of various solutes at different electrolyte concentrations are examined. Results indicate that solutes move slower in rough nanochannels than in smooth ones for both pressure-driven and electroosmotic flows. Solute separation can be significantly improved by surface roughness under certain circumstances.

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