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Identification of concentration polarization regimes in microchannel-nanochannel interfaces using method of characteristics ALI MANI, TOM ZANGLE, JUAN SANTIAGO, Stanford University — We developed a simple transport model to study concentration polarization (CP) regimes in microchannel-nanochannel interfaces. The models include advection due to electroosmosis, pressure-driven flow, electro migration, and diffusion. The electric double layer effects are assumed to be confined to near wall regions. This model is used to study CP in a series microchannel-nanochannel-microchannel geometry and found to provide significant insight into dynamics of CP. Consistent with experimental observations, two different CP regimes are identified: In one regime CP enrichment and depletion zones remain local to the channel interfaces (CP without propagation). In another regime, CP zones show long range propagation in the form of concentration shocks (CP with propagation). Solutions based on the method of characteristics are shown to uniquely determine which CP regimes will be selected by the system. We find propagation of CP is determined by two major system parameters: a nanochannel Dukhin number, and the ratio of the co-ion mobility to electroosmotic mobility. We found that after CP propagates, the system cannot be affected by perturbations to the reservoir. Extension of this model to more complex geometries will be discussed.

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