

1108-35-282

Mingji Zhang*, 619 Rred Cedar Road, East Lansing, MI 48824, and **Peter Bates, Guojian Lin, Weishi Liu, Hong Lu and Yingfei Yi.** *Effects of ion size and ion valence on ionic flows via Poisson-Nernst-Planck models with a local hard-sphere potential.*

We analyze a one-dimensional Poisson-Nernst-Planck model for ionic flows. We consider two ion species, one positively charged and one negatively charged, and assume zero permanent charge. A local hard-sphere potential that depends pointwise on ion concentrations is included in the model to account for ion size effects on the ionic flow. The model problem is treated as a boundary value problem (BVP) of a singularly perturbed differential system. Our analysis is based on the geometric singular perturbation theory but, most importantly, on specific structures of this concrete model. The existence of solutions to the BVP for small ion sizes is established and, treating the ion sizes as small parameters, we also derive an approximation of the I-V (current-voltage) relation. Based on that, critical potentials or voltages for ion size and valence effects are identified and their roles in characterizing the effects on ionic flows are discussed. Important scaling laws of I-V relations and critical potentials in boundary concentrations are obtained. Similar analysis is applied for individual flux of charge, which provides detailed information on the interaction among different ions. This is related to the selectivity phenomena of ion channels. (Received January 16, 2015)