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The electrokinetic transport of multivalent electrolytes: the effect of charge inversion

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Abstract

Devices integrated by nanoconduits hold great potential for clinical and biochemical analysis due to amplified sensibility, faster response and increased portability. In nanoconduits, wherein the electrical double layer may occupy a considerable part of the channel, the hydrodynamics of multivalent electrolytes is highly influenced by interfacial electrokinetic phenomena, such as charge inversion (CI). We conduct atomistic simulations of an electrolyte solution which consists of water as solvent, chlorine as co-ion and different counter-ions, i.e., sodium, magnesium and aluminum. We model Electroosmotic (EOF), Poiseuille (PF) and Couette (CF) flow in silica nanochannels to probe the relation between CI and transport properties. In EOF, we observe that changes induced by CI in the electrokinetic driving force at the diffuse layer, significantly alter the velocity distributions. Moreover, cases of CF and PF flow show that the position of the shear plane is significantly altered by the presence of CI. We find that the nanoconfined electrolytes can be modeled as two immiscible fluids with different transport properties with the shear plane as dividing surface.

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