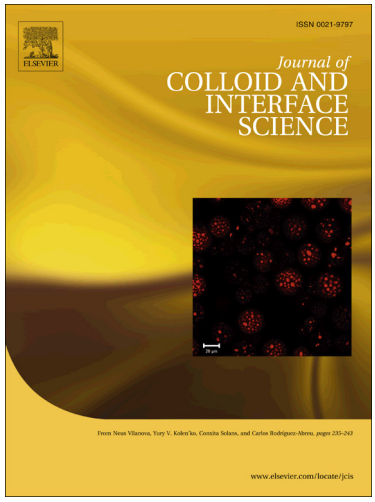

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Electro-osmosis in inhomogeneously charged microporous media by pore-scale modeling

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Abstract

Surface charge at solid-electrolyte interface is generally coupled with the local electrolyte properties (ionic concentration, pH, etc.), and therefore not as assumed homogeneous on the solid surfaces in the previous studies. The inhomogeneous charge brings huge challenges in predictions of electro-osmotic transport and has never been well studied. In this work, we first propose a classification of electro-osmosis based on a dimensionless number which is the ratio of the Debye length to the characteristic pore size. In the limit of thin electrical double layer, we establish a pore-scale numerical model for inhomogeneously charged electro-osmosis including four ions: Na^+, Cl^-, H^+ and OH^-. Based on reconstructed porous media, we simulate the electro-osmosis with inhomogeneous charge using lattice Boltzmann method. The nonlinear response of electro-osmotic velocity to applied electrical field and the reverse flow have been observed and analysed.

Keywords:
Electro-osmosis, inhomogeneous Charge, pore-scale modeling, microporous media, thin electrical double layer model

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