

Abstract Submitted
for the 4CF15 Meeting of
The American Physical Society

Mobility of nanometer-size solutes in water driven by electric field

MOHAMMADHASAN DINPAJOOH, DMITRY V. MATYUSHOV, Arizona State University — We investigate the mobility of nanometer-size solutes in water induced by a uniform external electric field. General arguments are presented to show that a closed surface cutting a volume from a polar liquid will carry an effective non-zero surface charge density when preferential orientation of dipoles exists in the interface. This effective charge will experience a non-vanishing drag in an external electric field even in the absence of free charge carriers. Numerical simulations of model solutes are used to estimate the magnitude of the surface charge density. We find it to be comparable to the values typically reported from the mobility measurements. Hydrated ions can potentially carry a significant excess of the effective charge due to over-polarization of the interface. As a result, the electrokinetic charge can significantly deviate from the physical charge of free charge carriers. We propose to test the model by manipulating the polarizability of hydrated semiconductor nanoparticles with light. The inversion of the mobility direction can be achieved by photoexcitation, which increases the nanoparticle polarizability and leads to an inversion of the dipolar orientations of water molecules in the interface.

Mohammadhasan Dinpajoo
Arizona State University

Date submitted: 26 Aug 2015

Electronic form version 1.4