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Nanohydrodynamics within the electrical double layer LYDERIC BOCQUET, University Lyon, France — Charge transport in nanochanels is investigated using molecular dynamics. We focus in particular on the microscopic origin of the widely used "Zeta potential." We show that the definition of this quantity not only involves the electrostatic nature of the interface, but is also intrinsincaly related to the dynamics of the solvent at the solid surface, providing new perspectives to control this quantity. We show in particular that the dynamics of the electric double layer (EDL) is very much dependent on the wettability of the charged surface on which the EDL develops. For a wetting surface, the dynamics, characterized by the so-called Zeta potential, is mainly controlled by the electric properties of the surface, and our work provides a clear interpretation for the traditionally introduced immobile Stern layer. In contrast, for non-wetting surfaces the immobile layer disappears and the Zeta potential deduced from electrokinetic effects is considerably amplified by the existence of a slippage at the solid substrate. The existence of strongly amplified electro-osmotic effects is accordingly demonstrated. Simulation results are shown to be in excellent agreement with predictions taking into account the slippage of the fluid the solid surface. The amplification effect is accordingly controlled by the ratio between the slip length (of the fluid at the solid surface), and the debye length. Such effects open the possibility of strongly enhanced electro-osmotic and electrophoretic effects in microchanels.

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