Charge Inversion in the Electrical Double Layer: Applications and Theory

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Recent advances in the theoretical underpinnings of charge inversion in the electrical double layer and its practical applications in nanofluidic devices are discussed. In charge inversion, more counterions than necessary to neutralize a surface charge accumulate, leading to an increase in co-ions in the second layer of ions near the surface. When electrolytes that produce charge inversion are confined in a nanoscale slit between two charged walls, this can reverse the flow of fluid. We have recently used this phenomenon in nanofluidic devices for practical applications and can also to better understand the physics of charge inversion. To define the statistical mechanical origins of charge inversion, we have recently used the primitive model of electrolytes and classical density functional theory of fluids to show how different components of the electrochemical potential combine to produce charge inversion.