Analysis of electrowetting of electrolyte solution in a nanochannel with overlapped electric double layer

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Electrowetting has been studied for its wide range of application in microfluidic/nanofluidic actuation. Especially in a nanochannel of O(10nm), the electric double layer is expected to be overlapped. In this work, electrowetting in a nanochannel is studied using cylindrical coordinate system. Poisson-Boltzmann equation is solved to obtain the electric potential distribution in a nanochannel with the given voltage at the channel wall. Under the low voltage approximation, the problem is analytically handled. First the average electrocapillarity effect is estimated. Then with the force balance at the electrolyte-gas interface, the deformed shape of the meniscus is analyzed based on the first order perturbation method.