171a Electrokinetic Transport in Nanoscale Fluidic Channels

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The flow of fluids (pure liquids and solutions) in very narrow channels enjoys a substantial attention with the rapid development of the fields of micro and nanofluidics. Miniaturized integrated fluidic devices have a great potential for enhanced separation and analysis by reducing the required time and the sizes of the samples. In channels of submicron dimension the electrokinetic phenomena play a particularly important role since the electric double layers formed at the walls can occupy a substantial part of the channel volume. This presents a theoretical difficulty and specific problems are usually treated numerically and in a non-comprehensive way. In our work we present a concise theory that allows obtaining analytical expressions for the transport of fluid (electroosmotic flow), ions (electric current) and dissolved charged molecules (analytes). The model is based on the weak double layer approximation and has a wide range of validity. A unique feature of this theoretical approach is that it is applicable not only to symmetric but also to asymmetric 2:1 and 1:2 electrolytes which exhibit very interesting properties in nanoscale channels. The possibility of affecting the wall zeta potential by applying a transverse voltage bias is also analyzed. This transverse bias is used in an attempt to control the transport in the channel and such devices are often called “fluidic field effect transistors”. Our model quantifies the effect of the voltage bias on the zeta potential of the channel wall and therefore can be used for prediction of transport and optimization of separations in such fluidic devices.