Electrokinetic Transport in Nanochannels

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The transport of fluids through conduits with nanometer dimensions (nanofluidics) is an area of study that has received little attention although the process is fundamental to life. We are currently investigating electrokinetic transport through nanometer scale channels fabricated in glass and silicon substrates. When the channel dimensions are large, e.g. 10 μm, the electric double layer thickness is negligible compared to the channel dimensions, and the flow profile is planar normal to the axis of flow. However, when channel dimensions begin to approach the double layer thickness, flow rates are expected to decrease with cross-sectional area in a non-linear fashion. To test this theory, we fabricated devices with channels that were confined to the nanometer range in one dimension (depth), measured the electroosmotic mobilities over a range of double layer thicknesses, and compared the results to theory. The average electroosmotic mobilities in fluidic channels where the double layer thickness was a significant fraction of the channel depth were reduced and compared well with theory. Flow through these nanometer deep channels has been applied to generating hydraulic pressures and separating DNA.

Research sponsored by the Defense Advanced Research Projects Agency under MIPR #02-N316-00. Oak Ridge National Laboratory is managed and operated by UT-Battelle, LLC, under contract DE-AC05-00OR22725 with the U.S. Department of Energy.