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Field-effect control of ion-transport in nanofluidic channels
ANKIT RAJ, DAEJOONG KIM, MARK SHANNON, Department of Mechanical Science and Engineering, University of Illinois, Urbana-Champaign — Ion transport in nanoscale channels has recently received overwhelming attention due to various promising applications. The Debye length being comparable to the channel dimensions leads to some interesting consequences like ion-exclusion-enrichment effect. The flow is dominated by surface charges within the nanochannel due to high surface to volume ratio. By varying the surface charge at the walls of the nanochannel with the application of a gate voltage the flow of ions can be controlled due to its effect on the concentration of the co-ions/counter-ions inside the nanochannel. To observe the concentration polarization of ions due to a nanochannel and to get conductivity measurements, we have fabricated a planar nanochannel structure in a silicon-glass device using conventional micro-fabrication techniques with heavily doped silicon substrate as the gate electrode that can help vary the surface charge on the walls of a nanochannel. We study the concentration polarization for charged fluorescent dyes like fluorescein and rhodamine 6G and the effect of the gate potential on this phenomenon for various salt concentrations. Also, we measure the conductivity of ions through the nanochannel and can vary it with the application of a gate voltage. We present a detailed characterization of gate effect on ion-conductivity through nanochannels for various salt concentrations.

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