Poster

Probing nanoscale fluid environment around individual carbon nanotube

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With recent advances in nanofabrication and simulation techniques, the study of fluid properties in or around nanoscale size objects, or nanofluidics, is a subject of growing interest [1]. However, obtaining a nanoscale probe to study experimentally such fluid properties remains challenging. Our proposed approach is based on electrolytically gated single nanotube devices in electrolyte solutions [2]. Such devices integrated in microfluidic channels have been demonstrated to probe electrokinetic phenomena and also function as nanoscale flow sensors [3]. As a next step, our on-going work focuses on the nanoscale fluid properties surrounding the single nanotube device. To that end, we study transconductance of multiwalled carbon nanotube devices. Indeed, the nanotube transconductance depends on the geometrical capacitance set by the ionic distribution surrounding the nanotube [2]. We demonstrate that the ionic distribution depends on the sign of the surface charge as well as on the nature of the solvent used. Moreover, at the charge neutrality point we observe reproducible changes of the nanotube conductance as a function of ionic concentration. These results contrast with symmetric properties expected from a continuum Poisson-Boltzmann approach. However, similar asymmetric behaviors were predicted by molecular dynamic simulations [4,5] that more specifically take into account the molecular ion-surface and ion-solvent interactions. Based on our experimental results, a description of the nanotube surface fluid environment in response to different ionic and solvent environments is proposed.

References:

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