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Experimental demonstration of scaling behavior for ionic transport and its fluctuations in individual carbon nanotube LYDERIC BOCQUET, ELEONORA SECCHI, ANTOINE NIGUES, ALESSANDRO SIRIA, Department of Physics, Ecole Normale Superieure, Paris — We perform an experimental study of ionic transport and current fluctuations inside individual Carbon Nanotubes (CNT) with a size ranging from 40 down to 7 nanometers in radius. The conductance exhibits a power law behavior dependence on the salinity, with an exponent close to 1/3. This is in contrast to Boron-Nitride nanotubes which exhibits a constant surface conductance. This scaling behavior is rationalized in terms of a model accounting for hydroxide adsorption at the (hydrophobic) carbon surface. This predicts a density dependent surface charge with a exponent 1/3 in full agreement with the experimental observations. Then we measure the low frequency noise of the ionic current in single CNTs. The noise exhibits a robust 1/f characteristic, with an amplitude which scales proportionaly to the surface charge measured independently. Data for the various CNT at a given pH do collapse on a master curve. This behavior is rationalized in terms of the fluctuations of the surface charge based on the adsorption behavior. This suggests that the low frequency noise takes its origin in the process occuring at the surface of the carbon nanotube.

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