

## Electrolyte transport through single-walled carbon nanotubes

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The strong interest for nanofluidics stems from the unique transport phenomena that appear as fluids are confined in nanoscale geometries where surface effects become of central importance. Among the different nanochannels studied so far, single-walled carbon nanotubes (SWCNTs) have gained special attention due to their perfect tubular structure, their high aspect-ratio and their smooth walls in addition to other remarkable mechanical, electronic and optical properties. However, creating and studying SWCNT-based nanofluidic systems free of damage, plugs or leaks remain extremely challenging [1]. We will present ionic current measurements through microfluidic devices containing one or several SWCNTs with diameters between 1.2 to 2 nm showing a linear or, unexpectedly, a voltage-activated, i.e. a non-linear, I-V dependence [2,3]. Transition from an activated to a linear behaviour and stochastic fluctuations between different current levels were notably observed. For linear devices, the high conductance confirmed with different chloride salts indicates that the nanotube/water interface exhibits both a high surface charge density and flow slippage, in agreement with previous reports. In addition, the sublinear dependence of the conductance on the salt concentration points toward a charge-regulation mechanism. Theoretical modelling and computer simulations show that the voltage-activated behaviour can be accounted for by local energy barriers along or at the ends of the nanotube. Raman spectroscopy reveals strain fluctuations along the tubes induced by the polymer matrix but displays insufficient information about doping or variations of doping to account for the apparent surface charge density and energy barriers revealed by ion transport measurements. Finally, experimental evidence points toward chemical moieties at the nanotube mouths as being responsible for the voltage-activated transport of ions through SWCNTs within this diameter range.

1) "Fabrication of Microfluidic Devices for the study of Ion transport through Single-Walled Carbon Nanotubes", Yazda et al, MRS Advances, 1(28), 2085-2090, (2016)

2) "Evidence of selective cation transport through sub-2 nm single-walled carbon nanotubes", Yazda et al, MRS Advances, 1(28), 2079-2084, (2016)

3) "Voltage-activated transport of ions through single-walled carbon nanotubes", Yazda et al, Nanoscale 9, 11976, (2017)