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Ohmic and voltage-activated transport of ions through single-walled carbon nanotubes

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We report studies of ion transport through SWCNTs with diameters of 1.2 to 2 nm showing a linear or, unexpectedly, a voltage-activated I-V dependence [1-3]. Transition from an activated to a linear behavior 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 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 behavior can be accounted for by local energy barriers at the ends of the nanotube. Raman spectroscopy reveals strain fluctuations along the tubes but insufficient doping or variations of doping to account for the apparent surface charge density and energy barriers revealed by ion transport measurements. Chemical moieties at the nanotube mouths are proposed to be responsible for the voltage-activated transport of ions through SWCNTs within this diameter range.

1) Yazda et al, *MRS Advances*, 1(28), 2085.

2) Yazda et al, *MRS Advances*, 1(28), 2079

3) Yazda et al, *Nanoscale* (2017), 9, 11976