73b Pressure Driven Flow and Hydrogen Bonded Ordering of Liquids inside Carbon Nanotubes

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Fluid and molecular transport through the hollow cores of carbon nanotubes, which exhibit ordered graphitic structure, large scale hydrophobicity in nano-confinement has been the subject of intense theoretical research. A membrane structure containing substantially high density (~ 1010/cm2) of aligned multiwalled carbon nanotubes with inner pore diameter (~ 7 nm) spanning across a continuous polystyrene matrix, provides a platform to experimentally measure liquid transport through the inner cores of carbon nanotubes in macroscopic quantities. Polar liquids such as water, ethanol, iso-propyl alcohol and non-polar solvents such as hexane and decane have observed pressure driven flow velocities through inner cores of the CNTs, which are 4-5 orders of magnitude higher than that predicted from Haagen-Poiseuille equation, suggesting ‘slipping' on the frictionless surfaces of the graphitic core. The slip lengths were found to decrease with increasing hydrocarbon chain length for the liquids. The observed flow velocities are in close agreement with theoretical predictions. Effects of ‘nano-confinement' induced hydrogen bonded ordering are also observed for the associative liquids, slowing the flow through the CNTs with time.