Carbon nanotube-based coatings to induce flow enhancement in hydrophilic nanopores

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Carbon nanotube-based coatings to induce flow enhancement in hydrophilic nanopores.[1] ENRIQUE WAGEMANN , Universidad de Concepcion, J. H. WALTHER, Technical University of Denmark, HARVEY A. ZAMBRANO, Universidad de Concepcion — With the emergence of the field of nanofluidics, the transport of water in hydrophilic nanopores has attracted intensive research due to its many promising applications. Experiments and simulations have found that flow resistance in hydrophilic nanochannels is much higher than those in macrochannels. Indeed, this might be attributed to significant fluid adsorption on the channel walls and to the effect of the increased surface to volume ratio inherent to the nanoconfinement. Therefore, it is desirable to explore strategies for drag reduction in nanopores. Recently, studies have found that carbon nanotubes (CNTs) feature ultrafast water flow rates which result in flow enhancements of 1 to 5 orders of magnitude compared to Hagen-Poiseuille predictions. In the present study, CNT-based coatings are considered to induce water flow enhancement in silica nanopores with different radius. We conduct atomistic simulations of pressurized water flow inside tubular silica nanopores with and without inner coaxial carbon nanotubes. In particular, we compute water density and velocity profiles, flow enhancement and slip lengths to understand the drag reduction capabilities of single- and multi-walled carbon nanotubes implemented as coating material in silica nanopores.

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