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Multiphase fluids confined in carbon nanotubes CONSTANTINE MEGARIDIS, University of Illinois at Chicago, YURY GOGOTSI, Drexel University, ALEXANDER YARIN, Technion-Israel Institute of Technology — The dynamics of liquid attoliter volumes contained in carbon nanotubes is investigated theoretically and experimentally. The experiments employ electron microscopy to visualize multiphase fluids in real time with spatial resolution approaching 1nm. The hydrophilic nanochannels studied include hydrothermally synthesized, CVD and commercially produced carbon nanotubes with inner diameters in the range 5-300 nm and wall thickness ranging from 1 nm to 40 nm. Dynamic phenomena are presented for aqueous fluids contained in closed-end nanotubes, and pure water condensing inside open-end carbon nanotubes. Some examples are given on filling nanotube channels with fluids impregnated with solid particles. A theoretical model formulated using a continuum approach, combines temperature-dependent mass diffusion with intermolecular (Lennard-Jones) interactions in the fluid bulk, as well as in the vicinity of the carbon walls. Several axisymmetric cases are considered, and comparisons between theoretical predictions and experimental data are performed. The current study shows the potential of using nanotube channels for understanding fluid behavior at the nanoscale.

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