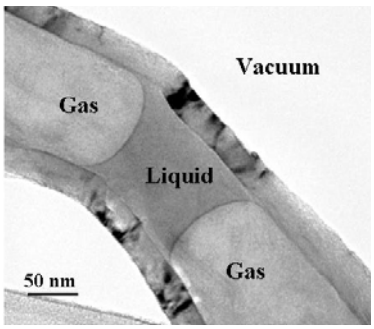
Nanotube-Based Nanofluidic Devices and Fundamental Fluid Studies at the Nanoscale

The study of transport of liquids though nanotubes has attracted considerable attention in recent years because of the interest in understanding the motion of highly confined liquids [9,10] and the technological promise of using these tubes for building novel nanofluidic devices [11]. Carbon nanotubes (CNT) are a convenient material for several reasons. First, CNT are hollow, relatively straight and long, have relatively uniform diameters, and can be fabricated with diameters ranging from one to several hundred nanometers. Second, the tube surface properties can be modified thermally and/or chemically to achieve controlled behaviors ranging from hydrophilic to superhydrophobic. Third, the tube walls are sufficiently thin to be transparent to light and electrons, allowing one to observe and quantify events that take place inside the tubes [12-14]. Fourth, due to their small size, the tubes provide a unique opportunity for studying fundamental flow physics phenomena, such as slip flow, contact line motion, etc.



The adjacent figure shows a transmission electron photomicrograph of an elbow portion of a capped carbon nanotube made hydrothermally [15]. The tube contains a liquid inclusion constrained between two menisci separating the aqueous liquid from the adjoining gas. The nanotube rests on a holey carbon grid, a segment of which is visible in the lower left corner of the micrograph. The volume of the liquid inclusion is of the order of 10^{-18} (*atto*) liters.

Specific tasks of the REU fellows include the performance of fluid-filling nanotube experiments using numerous types of commercial carbon nanotubes, as well as the performance of electron-microscope characterization, ranging from imaging to chemical analysis. In addition, the REU fellows will be exposed to an array of other ongoing projects in the Micro/Nanoscale Fluid Transport Laboratory at UIC, which is co-directed by Drs. Megaridis and Yarin. These projects range from micro- and nanofluidic applications in electronics manufacturing, to drug release from nanofiber assemblies. The research, although performed on a nanoscale system, produces visual images that do not require extensive training in interpreting them. While the research is of fundamental nature, it is also directly related to several technologies such as the development of nanofluidic devices utilizing nanopipes for drug delivery, nanofluidic sensors, etc.

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