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Solution-based electric-field-assisted assembly of vertically aligned CNT membranes RICHARD CASTELLANO, CEVAT AKIN, JERRY SHAN, Rutgers University — Carbon-nanotube (CNT) membranes are of interest due to experiments and simulations showing flow through nanotubes to be 3 to 5 orders of magnitude faster than predicted by viscous flow theory. Thus, membranes incorporating vertically aligned CNTs (VACNTs) as through-pores offer promise as highly efficient and permeable membranes for a variety of filter and separation processes. However, current membrane-fabrication techniques utilizing CVD-grown VACNT arrays are costly and difficult to scale up. We are developing a solution-based, electric-field-assisted approach as a cost-effective and scalable method to producing large-area VACNT membranes and composites. Post-growth nanotubes are first dispersed in a polymeric matrix and then aligned with an AC electric field. A DC component induces electrophoresis to the CNTs to significantly increase the VACNT number density. This composite field also introduces complex fluid motion caused by induced-charge electro-osmosis and the electrochemistry of the fluid/electrode interface. We experimentally probe all of these effects and consider factors affecting the number density and spatial uniformity of VACNT membranes. We also consider the basic electrokinetics of nanotube alignment under spatially uniform AC electric fields, making quantitative comparison with classical models of the dynamics of polarizable, 1D particles under the combined effects of electric fields, hydrodynamic drag, and Brownian motion. We conclude by discussing the implications of these fundamental electrohydrodynamic studies for producing large-area membranes containing aligned CNTs.

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