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Electro-orientation of Carbon Nanotubes in Polymer Suspensions

RICHARD CASTELLANO, GABRIEL GIRALDO, CEVAT AKIN, JERRY SHAN, Rutgers University — Carbon nanotube (CNT) membranes have been of recent interest due to experiments and simulations that have found flow rates through nanotubes to be 2 to 3 orders of magnitude faster than predicted by viscous-flow theory. As such, they offer promise as highly permeable membranes for a variety of filtration and separation processes. However, current CNT-membrane fabrication techniques utilize CVD growth of CNTs which is costly and difficult to scale up. Electro-orientation of post-growth CNTs in polymer suspension is a possible cost-effective and scalable approach to producing aligned CNT membranes and composites. An electric field (E-field) applied to a prolate particle induces a dipole in the direction of the particle's major axis which causes the particle to rotate into alignment with the E-field. The alignment rate of CNTs in various polymer suspensions is experimentally studied here as a function of the applied E-field strength and frequency. When dealing with CNTs, thermal energy is a significant component of the particle motion, causing misalignment from the applied E-field. In order to quantify the significance of Brownian motion, we measure the probability distribution of alignment angles for CNTs at various field strengths. We compare our experimental results with theoretical predictions and discuss the implications for producing membranes of aligned CNTs by electro-orientation.

Jerry Shan
Rutgers University

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