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Reptation dynamics of single-walled carbon nanotubes in a permanent network NIKTA FAKHRI, Rice University, FRED MACKINTOSH, Vrije Universiteit, LAURENT COGNET, Universite de Bordeaux and CNRS, BRAHIM LOUNIS, Universite de Bordeaux, MATTEO PASQUALI, Rice University — Single-walled carbon nanotubes (SWCNTs) are an ideal system of semiflexible filaments with tunable bending stiffness. By exploiting their near-infrared fluorescence, we image directly the motion of SWCNTs in a network (agarose gel). We determine the SWCNT diameter (and bending stiffness) spectroscopically, and we control the network pore size by changing the agarose concentration. Image analysis shows clearly that SWCNTs move by reptation through the pore network. We quantify the dependence of SWCNTs mobility on SWCNT bending stiffness, length and pore sizes. Our results show conclusively that, even when the SWCNT length is much smaller than the persistence length, the flexibility of filaments enhances rotational diffusion. These results confirm earlier predictions of Odijk (1983), and show that the Doi-Edwards scaling fails to capture the filaments' motion. This study provides a fundamental understanding of reptation dynamics of semiflexible filaments.

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