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Brownian diffusion of single walled carbon nanotubes in highly confined rock-like porous media ZHAO TANG, SHANNON EICHMANN, FREDERICK MACKINTOSH, MATTEO PASQUALI, Chemical and Biomolecular Engineering Department, Rice University — Despite its importance in biophysics and energy, the thermal motion of stiff filaments in crowded environments is not completely understood. Recent experiments on the motion of single-walled carbon nanotubes (SWCNT) in gels showed that SWCNTs slither and rotate as predicted by Odijk theory and that even minimal flexibility can speed up diffusion in highly confined environments. However, it is not clear whether the same behavior would translate to other classes of crowded environments. For example, in porous media, the narrow connections between rock pores (i.e., pore throat) cause an extra confinement effect. The dependence of filament motion on such pore shapes is still not understood. Here, we use near-infrared microscopy to image the SWCNT diffusion in a heterogeneous submicron sized porous system made of randomly close packed silica colloids to mimic the structure of rocks. We show that for short SWCNTs, whose length is up to a few times the diameter of the beads, pore throats negligibly affect the SWCNT motion. Conversely, long SWCNTs frequently bend due to the narrowness of the pore throat that limits the SWCNT orientations. These results are crucial to understand the diffusive dynamics of SWCNTs used for oil detection in highly-confined porous media.

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