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Near-wall Brownian motion of anisotropic particles SADAO OTA, TONGCANG LI, YIMIN LI, ZILIANG YE, ANNA LABNO, XIAOBO YIN, M-REZA ALAM, XIANG ZHANG, UC Berkeley — Anisotropic microscopic objects are ubiquitous such as biological cells, filamentous macromolecules, as well as synthesized nanomaterial. Near interfaces, the thermal motion of these objects is strongly constrained due to the hydrodynamic interactions, impacting the overall behavior of the biophysical and colloidal systems. Thus, understanding this wall-effect is a key to describe many surface-related problems. Unlike the well-studied case of spheres, however, both its experimental and theoretical studies have been elusive due to the intrinsic complexity of the system. Here we present a comprehensive experimental and computational study of the Brownian motion of silicon nanowires tethered on a substrate. A uniquely developed interference method enables the direct visualization of its microscopic rotations in three dimensions with high angular and temporal resolutions. The quantitative measurement at short time scales revealed the anisotropic reduction in their rotational diffusivities as a function of the inclined angles, resulting in the decrease more than 40-80 % at long time scales. We then developed a numerical model from a string-of-beads idealization, which implicitly simulates the complex hydrodynamic interaction and showed excellent agreement with the experimental observations. Our study provides insights into the fundamental diffusive processes, useful for understanding the anisotropic behavior of anisotropic macromolecules near interfaces. The demonstrated methods offers a systematic approach for studying the interfacial rheology of various anisotropic objects.

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