Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Near-surface dynamics of semidilute polymer solutions: diffusion, nonlinear rheology, and the hydrodynamic boundary condition GABRIEL GUYARD, Université Paris-Saclay, CNRS, Laboratoire de Physique des Solides, ALEXANDRE VILQUIN, Gulliver CNRS UMR 7083, PSL Research University, ESPCI Paris, FRÉDÉRIC RESTAGNO, Université Paris-Saclay, CNRS, Laboratoire de Physique des Solides, JOSHUA MCGRAW, Gulliver CNRS UMR 7083, PSL Research University, ESPCI Paris — The near-surface dynamics of polymer solutions challenge both experimental and theoretical efforts, especially in the case of semi-dilute solutions for which chains overlap, yet evanescent wave microscopy allows for the characterization of such interfacial flows. Here we report molecular-size-resolution particle motions in microfluidic channels for pressure-driven flows of semidilute polymer solutions. The results using polymer-free water are in good agreement with Stokes-flow hydrodynamic and diffusive theory. Experiments using polyacrylamide at different volume fractions close to and above the overlap concentration are done in the same chips as for the water experiments. In contrast to Newtonian fluid behaviour, the shear-rate/pressure drop relation is non-linear for the polymer solution flows, suggesting nanometrically resolved, and shear-thinning effects, accompanied with a non-trivial hydrodynamic boundary condition. The diffusive motion of the tracer particles is also distinguished from that of the water experiments, and such motions detailed here. These results set the basis for a study of near-wall hydrodynamic flow and diffusion in complex fluids, notably including semidilute polymer solutions.

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Date submitted: 03 Aug 2020 Electronic form version 1.4