221b Concentration Effects on Chain Migration in Microfluidic Flow

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DNA manipulation in micro- and nano-fluidic channels has become an important tool for understanding the physical properties of a DNA molecule. Emerging applications that rely on DNA micromanipulation, such as optical mapping, are rapidly advancing the area of high-throughput genome analysis. In this work, the dynamics of DNA chains in microfluidic flow, confined by channels of dimensions comparable to the chain radius of gyration, are examined using two techniques, namely Brownian dynamics with hydrodynamic interactions (BD-HI) and the lattice Boltzmann method (LBM). Prior simulations and experiments have shown that DNA chains become stretched and migrate towards the channel center under pressure-driven flow. The present work investigates how inter-chain interactions affect the chain conformation and the depletion layer thickness by varying the chain concentration up to the dilute-semidilute crossover. We also examine the role of coarse-graining with dumbbells and chain models of different lengths. The efficiency of the BD-HI method and LBM are characterized and compared as a function of chain number density.