Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

A single polymer Brownian motor MATTHEW DOWNTON, Simon Fraser University, MARTIN ZUCKERMANN, Simon Fraser University, ERIN CRAIG, University of Oregon, MICHAEL PLISCHKE, Simon Fraser University, HEINER LINKE, University of Oregon — We study a polymer chain in a flashing ratchet potential to determine how the mechanism of this Brownian motor system is affected by the presence of internal degrees of freedom. Each monomer is acted upon by a 1D asymmetric, piecewise linear potential of spatial period L comparable to the radius of gyration of the polymer. We characterize the average motor velocity as a function of L, $T_{\rm off}$, and N to determine optimal parameter ranges, and we evaluate motor performance in terms of finite dispersion, Peclet number, rectification efficiency, stall-force, and transportation of a load against a viscous drag. We find that the polymer motor performs qualitatively better than a single particle in a flashing ratchet: with increasing N, the polymer loses velocity much more slowly than expected in the absence of internal degrees of freedom, and the motor stall force increases linearly with N. To understand these cooperative aspects of motor operation, we analyze relevant Rouse modes. The experimental feasibility is analyzed and the parameters of the model are scaled to those of λ-DNA. Finally, in the context of experimental realization, we present initial modeling results for a 2D flashing ratchet constructed using an electrode array.

Matthew Downton
Simon Fraser University

Date submitted: 30 Nov 2005

Electronic form version 1.4