Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

A concept for an artificial single-molecular motor MATTHEW DOWNTON, MARTIN J ZUCKERMANN, MICHAEL PLISCHKE, Simon Fraser University, ERIN CRAIG, HEINER LINKE, University of Oregon — In this study we present and examine by numerical simulation a polymer based theoretical concept for an artificial single-molecular motor. We model the motor potential by a 'flashing ratchet' in which non-equilibrium fluctuations bias Brownian motion in an asymmetric periodic potential without macroscopic force fields. For the potential we choose either an asymmetric saw tooth model or an asymmetric periodic potential created by alternating infinite line electrodes of positive and negative charge respectively. The polymer models a DNA molecule which is assumed to have a total length much greater than its persistence length and is thus simulated by Brownian molecular dynamics on a freely jointed polyelectrolyte with Lennard-Jones potentials between all monomers. We report the results of several numerical calculations using this model. These include (a) the polymer velocity as a function of the periodic length of the potential, the polymer length and the off-time of the flashing ratchet when the potential is switched off and the polymer diffuses freely, (b) stall force and motor efficiency, (c) the effect of a load on the kinetics of the polymer, (d) the conditions for reversal of polymer motion and (e) the detailed characteristics of the polymer in the ratchet potential. We predict optimal design parameters for a related experimental project.

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Date submitted: 02 Dec 2004 Electronic form version 1.4