Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Stick-Slip Motion of DNA in a Solid Nanopore[1] BINQUAN LUAN, GLENN MARTYNA, IBM TJ Watson Research Center — Nanopore technology is a potential solution for the low-cost and high-throughput DNA sequencing. Till now, in a typical experiment DNA driven by an electric field translocates through a nanopore too fast to be detected at a single-base resolution. The recently proposed DNA transistor (Appl. Phys. Lett. 91, 153103 (2007)) holds the promise to trap DNA inside a nanopore and translocate single-stranded DNA (ssDNA) at a single-base resolution. Using extensive all-atom molecular dynamics simulations, we modeled the process of ssDNA's translocation through the DNA transistor when ssDNA is pulled by an optical tweezer. We found a stick-slip type of motions of DNA when both the stiffness of an optical tweezer and the pulling velocity are below critical values. This irregular motion of DNA is quantitatively characterized using the Tomlinson model. In a typical slip event, ssDNA advances one nucleotide spacing, while in a stick state the base of DNA can be conveniently measured. The duration of a stick state depends on the strength of a trapping field in the DNA transistor, the stiffness of an optical tweezer and the pulling velocity. Therefore, the controlled stick-slip motion of DNA is ideal for DNA sequencing methods using a solid nanopore.

[1]Authors acknowledge the usage of IBM Bluegene supercomputers.

Binquan Luan
IBM TJ Watson Research Center

Date submitted: 07 Dec 2008 Electronic form version 1.4