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Stepping dsDNA through a solid-state nanopore one basepair at a time[1] ANTHONY HO, JEFFREY COMER, ALEKSEI AKSIMENTIEV, Department of Physics, University of Illinois at Urbana-Champaign — Solid-state nanopores hold great promise for single-molecule detection and manipulation, including low-cost, high-speed DNA sequencing. In a typical experiment, single molecules of DNA are driven through a nanopore by applying an electric potential difference across the membrane. As DNA passes through the pore, it modulates the ionic current, which potentially can be used to determine the DNA sequence. However, the typical rate of DNA transport in experiment is too high for detection of DNA sequences by ionic current measurement. It has been shown that it is possible to slow and weakly trap dsDNA in solid-state nanopores with diameters smaller than that of dsDNA [Nanotechnology 21:395501]. Using all-atom molecular dynamics simulations, we demonstrate that such pores can be used not only to trap but also to displace dsDNA in discrete steps using nanosecond-long pulses of electric field. Specifically, we have identified the pore geometry and pulse profiles that impel dsDNA by one basepair when the pulse is on and retain dsDNA in the same position when the pulse is off. Such nanopore traps may offer new means for manipulating single molecules in biophysics experiments.

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