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Nanofilters for high throughput DNA separation NABIL LAACHI, University of Minnesota, CARMELO DECLET, University of Puerto Rico-Mayaguez, CHRISTINA MATSON, Mississippi State University, KEVIN DORFMAN, University of Minnesota — Nanofilters are a novel class of microfabricated devices for rapidly separating short, rigid DNA. The succession of alternating narrow slits ($\sim$50nm) and deep wells ($\sim$300nm) is used to trap the DNA, which then escape at a size-dependent rate. Experiments and near-equilibrium theoretical arguments both indicate that smaller DNA travel faster in a weak field, but the separation fails at around 100V/cm. We theoretically show that the speed and performance of the device can be enhanced using high fields of several hundred V/cm. Based on scaling arguments, the separation of short, rod-like DNA molecules at high fields occurs via "torque-assisted escape," which originates from the non-uniform electric field at the slit entrance. The quadratic dependence of the torque on the molecule size indicates that larger molecules will now emerge first; under a high field, the device operates in a band-inverted manner. Brownian dynamics simulation results confirm the mobility increase with size, with a quasi-plateau at very large fields.

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