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Non-Equilibrium DNA Dynamics Probed by Delayed Capture and Recapture by a Solid-State Nanopore[1] MIRNA MIHOVILOVIC, ERIN TEICH, NICHOLAS HAGERTY, DEREK STEIN, Brown University — We studied the relaxation of λ-DNA following its translocation through a voltage-biased solid-state nanopore. The translocation process drives DNA into a non-equilibrium state because the $\sim$2 ms translocation time is roughly fifty times shorter that the polymer's characteristic (Zimm) relaxation time. By reversing the applied voltage at controlled delay times after a translocation event, the nanopore probed the configurations of recaptured molecules at various stages of relaxation. We monitored the disruptions of the ionic current through the nanopore and computed the integrated charge deficits (ECDs) resulting from DNA translocations. As the delay time between voltage reversals was decreased from 50 ms to 5 ms, the distribution of ECDs shifted to lower values. Furthermore, an increasing fraction of recapture events occurred in a shorter interval from the voltage reversal than the delay time. These observations are explained by the expansion of the DNA coil as it approaches equilibrium. Finally, we show that recapturing a molecule multiple times and averaging the ECDs reduces the measurement error, which is useful for molecular diagnostic applications. The variance decreases approximately as the inverse number of passes through the pore.

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