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Measuring the confinement free energy of DNA in nanofluidic cavities ALEXANDER KLOTZ, WALTER REISNER, McGill University — It is possible to dictate the equilibrium conformation of single DNA molecules in nanofluidic systems by creating topographies where confinement varies over scales of nanometers to microns. Much work has been done to elucidate the polymer physics of systems with simple 1D or 2D confinement, but there is little quantitative understanding of behavior in more complex systems. Using single-molecule fluorescence microscopy, we study the equilibrium conformation of single DNA molecules partitioning into a single nanoscale pit etched in a nanoscale slit. In this system the polymer exists in a conformation which is partially occupying the nanopit and partially outside in the slit: the fraction of contour filling the pit is determined by a balance of confinement free energy and self-avoidance. We measure statistical distributions of this filling fraction resulting from fluctuations of contour in and out of the slit. These distributions are measured as a function of slit height and pit width and interpreted in terms of free energy models based on the balance of confinement free energy and self-avoidance. These measurements serve as a unique experimental probe of cavity-like polymer confinement, a system with rich phase behavior that has not been probed experimentally. Together with previous work on the statistics of molecules spanning multiple pits, we can use this system to make measurements of the free energy of confinement and self-avoidance effects in confined systems, essential quantities in the design of nanofluidic devices for DNA manipulation.

Alexander Klotz
McGill University

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