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Conformational Sculpting of DNA: Nanofluidics for Single Molecule DNA Analysis and Manipulation

When a polymer is confined in a structure with dimension below the polymer's free solution gyration radius, the confining geometry will alter the polymer equilibrium conformation. This fundamental result of statistical physics has a key technological implication: polymer conformation can be manipulated and controlled onchip by design of the nanofludic confining geometry. This talk will consider two implications of this notion of 'conformational sculpting' for the field of single molecule DNA analysis. (1) Nanopit structures embedded in a nanoslit are used to control local DNA conformation and positioning without the need for local surface chemistry. (2) Nanochannel and nanogroove structures are used to stretch out single DNA molecules, creating a linear unscrolling of the genome along the channel for analysis. In particular, we will discuss how nanochannel based DNA stretching can serve as a platform for a new optical mapping technique based on measuring the pattern of partial melting along the extended molecules. We believe this melting mapping technology is the first optically based single molecule technique sensitive to genome wide sequence variation that does not require an additional enzymatic labeling or restriction scheme

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