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Dynamics of single DNA molecules in spatial confinement

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The direct imaging of dynamics of biopolymers in solution with atomic force microscopy and fluorescence microscopy offers a vivid insight in the fundamentals of molecule interactions. These methods contribute to the understanding of biophysical processes in living cells and to the development of gene sequencing techniques as well as artificial functional assemblies based on DNA or proteins.

We investigate the dynamics of fluorescently labeled DNA molecules in spatial confinement. Linear polymers like DNA build entropic coils in an aqueous solution. Elongation of these coils, for example in very narrow channels, simulates a highly dense state of DNA in living cells and ensures a better insight into different spatial regions of the polymer.

The experiments are carried out in microfluidic cells made of polydimethylsiloxane (PDMS) and covered with glass. The PDMS surface is patterned with channel submicrostructures by soft lithography and direct writing via focused ion beam. The insertion of DNA molecules into channels with diameters of a few hundred nanometers is supported by electrophoretic forces. Due to fluorescence labeling and the use of transparent materials for the cell, the diffusion of single molecules can be tracked by fluorescence microscopy.

The presentation discusses the preparation of the microfluidic channel system and transport measurements of DNA molecules through these nanoscopic channels.

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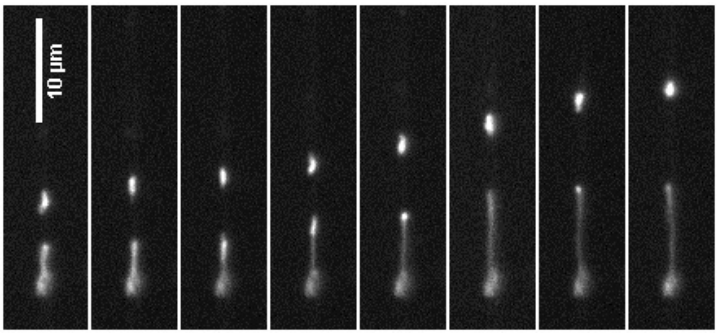

Figure 1: Micrograph series of an elongated fluorescent DNA coil during insertion into a submicrochannel.