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Spatial variation of knotting free energy and knot interactions in a knot factory on chip SUSAN AMIN, AHMED KHORSHID, LILI ZENG, PHILIP ZIMNY, WALTER REISNER, McGill University, REISNER GROUP TEAM — We demonstrate that DNA molecules can be knotted following hydrodynamic compression against nanofabricated barriers in nanochannels. In particular, we measure the probability of forming single or multiple knots on a chain as a function of compression and waiting time in the compressed state. We observe that knotting probability increases as the chain is compressed, with multiple knot states dominating for the highest compression achieved. In addition, we observe that knot formation probability increases with waiting time, enabling direct measurement of knot formation kinetics. Using a free energy derived from scaling arguments that incorporates full details regarding the non-uniform compressed ramp-like concentration profile, we show that the enhanced knotting probability at high compression arises by avoiding the free energy cost of high self-exclusion interactions due to contour stored in the knot. In addition, the knot spatial distribution along the chain suggests that multiple knots exhibit single-file diffusion in the channel, resulting in an increased knot interaction free energy.

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