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Entropy-driven DNA tug-of-war and confinement-induced reptation in 2D slitlike channels[1]

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Given its simplicity in geometry and fabrication, nanofluidic confinement, in the form of nanoslits, nevertheless offers unique platforms for the study of molecular biophysics and single molecule analysis [1-3]. Here, we established an entropy-driven single DNA tug-of-war (TOW) system composed of two micro-to-nanofluidic interfaces bridged by a nanoslit. This surprisingly simple system enables us to study polymer TOW dynamics and the conformation recovery through entropic recoiling, without using sophisticated external force apparatus such as optical tweezers, magnetic tweezers, and atomic force microscopy [4]. By changing the slit length and depth, we determined the scaling behavior of the entropic recoiling force (f_{rec}) on the nanoconfinement (h) to be $f_{rec} \sim 1/h$ for $h =$ 40-110 nm. This observation is also supported by our scaling analysis [5]. Further, we observed unexpected reptation of single DNA molecules in nanoslits of 25 nm height or less. The reptation behavior is quantitatively characterized using orientation correlation and transverse fluctuation analysis. We propose that tube-like polymer motion arises for a tense polymer under strong uniaxial confinement and the interaction with the surface-passivation polymers.

[1] L.J. Guo, X. Cheng, and C.F. Chou, *Nano Lett.* **4**, 69 (2004).
[2] J. Gu, R. Gupta, C.F. Chou, Q. Wei, and F. Zenhausern, *Lab Chip* **7**, 1198 (2007).
[3] T. Leïchlé, Y.L. Lin, P.C. Chiang, K.T. Liao, S.M. Hu, and C.F. Chou, *Sens. Actuators B* **161**, 805 (2012).
[4] J.W. Yeh, A. Taloni, Y.L. Chen, and C.F. Chou, *Nano Lett.* **12**, 1597 (2012). (*Nature* **482**, 442 (2012))
[5] A. Taloni, J.W. Yeh, and C.F. Chou, *Macromolecules* **46**, 7989 (2013).

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