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Shear unzipping of DNA: A semi-microscopic approach BUDDHAPRIYA CHAKRABARTI, DAVID R. NELSON, Lyman Laboratory of Physics, Harvard University, Cambridge, MA 02138 — The denaturation force of double stranded DNA in shear mode is observed to be much higher than the force required to unzip individual base pairs. We present an analysis of this problem using a nonlinear generalization of a model of shear unzipping first considered by deGennes. We find that the strain on the DNA is localized over a small region on either side of the chain. The nonlinear springs of length κ^{-1} acting in parallel on either side of the chain make the chain stiffer. The competition between this length scale κ^{-1} and the system size L gives rise to a system size dependent rupture force. While for small systems, the force scales as $F_c \approx f_0 L$, where f_0 is the rupture force of a single bond, it saturates to a value $F_c \approx 2\kappa^{-1} f_0$ for large systems. We explore the role of temperature and sequence heterogeneity on the unzipping process and discuss its implications in biology and material science.

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