

Nonequilibrium dynamics of polymer translocation and straightening

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長い高分子鎖は、その柔らかな弾性のためにゆっくりとしたダイナミクスを示し、比較的弱い外場に対して大きな非平衡応答をする。ここでは、(I) リラックスした高分子鎖の一端を急に引っ張った場合、(II) 高分子鎖が小さな穴に吸い込まれる場合の非平衡ダイナミクスを理論的に解析する。実験的には、それぞれ (I) AFM やレーザーピンセットによる一分子操作、(II) 細胞膜や核膜にあいた穴を通しての高分子の輸送現象に対応する。どちらの場合も、鎖の骨格に沿っての張力の伝播がダイナミクスが現象の理解の鍵となる。

When a flexible polymer is abruptly pulled by its end or sucked into a localized small hole, the chain can initially respond only locally and the sequential nonequilibrium processes follow in line with the propagation of the tensile force along the chain backbone. This process is closely related to the single polymer manipulation (currently available using atomic force microscopy or optical tweezer) and the polymer translocation through the pore in the membrane. We analyze the dynamics by taking the nonuniform stretching of the polymer into account both with and without hydrodynamics interactions [1]. Earlier conjectures [2, 3] on the straightening/absorption time are criticized and new formulae are proposed together with time evolutions of relevant dynamical variables.

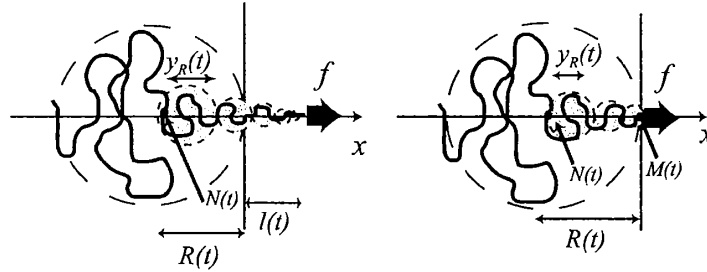


Figure 1: A dynamical response of a polymer initially at rest to the strong pulling by its one end (left) and to the strong aspiration into the spot at the origin (right).

References

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