Analyzing of DNA behavior in passing through micro-structures based on the Fokker-Planck equation and the entropic barrier model

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Abstract

We considered the motion of DNA molecules through a hexagonal array under uniform electric fields as a Fokker-Planck process which is affected by the entropic barriers; and we have simulated this motion by computer. We solved the Fokker-Planck equation with numerical simulation of the Brownian dynamics by the Euler method. For different DNA molecules, under different physical conditions, the mean value of velocity, variance, and \( \langle x^2 \rangle \) have been calculated, and the results have been compared with the Phase Diagram of our previous results. In the light of this comparison we could find the physics of the DNA behavior in different regimes. It is observed that in regime-1 (small DNA molecules under weak Electric force) we have a pure diffusion process, in regime-3 (large DNA molecules under high Electric field) the entropic barrier model is the dominated physics, and in regime-2 (medium DNA molecules under medium and relative high Electric fields) , which is a more complicated regime we have a drifted diffusion phenomenon.

Keywords: Fokker-Planck process, entropic barrier model, Langevin equation, time delay

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