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Kyoto University
Conformational Hysteresis on A Giant DNA Molecule

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1 Introduction

A single molecular fluorescence image experiment has been conducted to elucidate the conformational behavior of a giant DNA molecule in aqueous solution. By adding condensing agents, such as PEG (Poly Ethylene Glycol), a random coiled giant DNA molecule undergoes folding to form compact structure. [1, 2] Such a transition exhibits the features of the first-order phase transition, with two coexistent elongated and compact conformations. [1, 2] In this work, we carry out the titration and back-titration with an increase and a decrease of PEG concentration, respectively, to investigate the DNA conformation mediated by condensing agents.

2 Experiment

A giant T4 DNA (165.5 kbp) molecule in PEG solution shows two distinct conformational states, elongated and compact, which can be characterized through their large density difference (above $10^4$ times). Here, two sets of experiment are carried out, including titration and back-titration. In titration, the PEG concentration is increased by keeping the T4 DNA concentration fixed, whereas in back-titration, the PEG concentration is diluted. After mixing PEG with T4 DNA, the solution stands for 1 hour or 2 hours before the ratio of the compact state is measured.

3 Results and Discussion

Figure 1 displays the ratio of the compact state of a giant T4 DNA with PEG concentration obtained from titration and from back-titration. A pronounced conformational hysteresis is

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observed. In the titration experiment, more T4 DNA molecules fold as the PEG concentration is increased and/or after the solution stands for two hours. In back-titration, the T4 DNA molecule tends to unfold, but the ratio of compact conformation becomes independent of time. These results suggest different pathways between the forward and backward titrations.

4 Conclusions

The forward and backward titrations with PEG are conducted to investigate the conformational behavior of a giant T4 DNA molecule. Our findings show a pronounced conformational hysteresis for folding and unfolding processes, indicating different pathways for these processes.

Figure 1: Plot of the ratio of the compact state of a giant T4 DNA with PEG concentration obtained from forward titration, solid symbols, and from back-titration, open symbols after the mixture stands for one hour, circles, and for two hours, squares. The conformations of the two different states are shown: coiled DNA on left and globule DNA (condensed) on right.

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References
