Giant DNA in Water: Conformational Transition and Radiosensitivity

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During the last decade, based on the methodology of single DNA observation in water environment, it has been confirmed [1] that individual giant DNA molecules, larger than several tens of kilo base-pairs, undergo a large discrete transition in their higher-order structure. The fundamental characteristics of the transition are summarized as follows: 1) The structural transition between elongated coil and packed compact states in giant DNA is all-or-none on individual DNA molecules, whereas it seems continuous on the level of the ensemble of DNA molecules. 2) The discrete nature of the transition is rather general regardless the change of the mechanism of compaction by using different condensing agents, such as polyamine, hydrophilic polymer, cationic surfactant, etc. 3) When the degree of the charge neutralization is insufficient, intra-molecular phase segregation is generated, i.e., elongate and compact states coexist along a long DNA molecule.

In the present paper, we will show the results of our recent measurements on double-strand breaks on giant DNA caused by γ-ray irradiation. It is shown that double-strand breaks are significantly protected for the tightly compact DNA, whereas there is no apparent decrease on the damage for loosely aggregated DNA molecules. These results indicate the importance to explore the difference in the higher-order structure among “DNA condensation” in relation to their biological properties.

References [1] K.&Y. Yoshikawa, *"Compaction and condensation of DNA", in "Pharmaceutical Perspectives of Nucleic Acid-Based Therapeutics", eds., R. I. Mahato et. al.* (2002), pp. 137-163. [2] Y.&K. Yoshikawa, Chemistry Today (in Japanese), July issue, 2007.

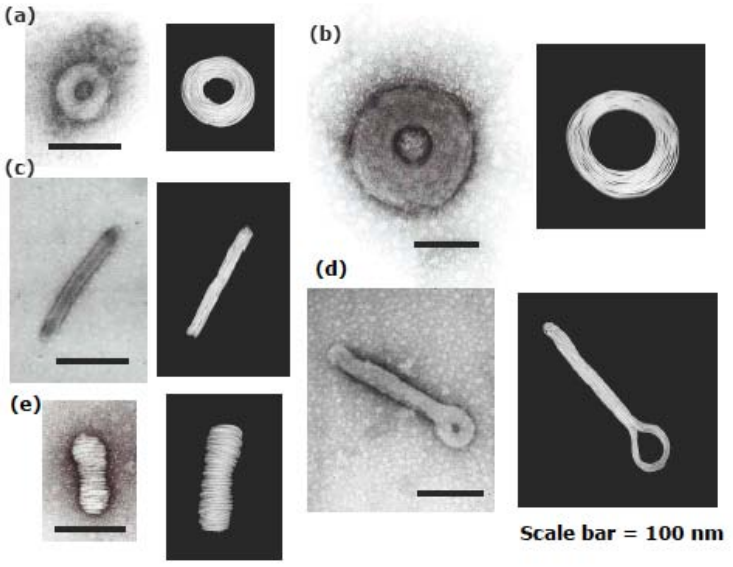

Fig. Electron micrographs on compact DNA molecules, together with the models made from semi-flexible rope on the right sides. [2]