Nanoscience of photofunctional DNA

Tetsuro Majima

(Osaka University, The Institute of Scientific and Industrial Research, Professor)

【Outline of survey】

In this research, photofunctional DNAs modified with various photofunctional chromophores and nano particles are used as reactive environments for constructing charge separation and charge transfer systems, and the photofunctional properties are assemblied on the surface to develop the photoelectric conversion devices using the advanced character of DNA as the building block of supramolecular structures.

Charge separation and charge transfer in DNA during the photoirradiation are important photoinduced processes with relation to photoelectric conversion, molecular wires, and DNA base damage in living cells. Therefore, this project is conducted to elucidate the mechanisms of the highly efficient and long-lived charge separation and charge transfer. The results can be applied to develop photofunctional DNA molecular wire, photoenergy conversion system, and highly effective DNA damaging method. The research subject of this project is focused on mainly "charge separation in DNA" to establish nanoscience based on photofunctional DNA: 1) establishing the highly efficient and long-lived charge separation in DNA, 2) construction of photofunctional DNA molecular wire, 3) construction of photoelectric conversion device using DNA modified with organic molecules and DNA-nano particles complex (application to photoenergy conversion method and gene diagnostic technique), and 4) clarification of DNA oxidation damaging mechanism and application to photodynamic therapy (PDT).

【Expected results】

Establishing the highly efficient and the long-lived charge separation in DNA causes to develop the photofunctional DNA molecular wire, high performance device with higher-ordered structural construction using DNA as the building block, and photoenergy conversion device, and relates directly to clarification of DNA oxidation damaging mechanism and application to photodynamic therapy (PDT). The mechanisms of the charge separation and charge transfer in DNA are also important subjects to clarify the characteristics of such processes in organic molecular assemblies with the pi-stacking structure from the basic point of view. Consequently, a new paradigm of charge separation and charge transfer in DNA will be established in chemistry.

【References by the principal researcher】

“Direct observation of hole transfer through double helical DNA over 100 Å”, T. Takada, K. Kawai, M. Fujitsuka, and T. Majima *Proc. Nat. Acad. Sci. U.S.A.* 101, 14002-14006 (2004).

“Two-color two-laser DNA damaging”, K Kawai, X. Cai, A. Sugimoto, S. Tojo, M. Fujitsuka, and T. Majima, *Angew. Chem. Int. Ed. Eng.*116, 2460-2463 (2004).

【Term of project】 FY 2005 - 2009

【Budget allocation】 82,400,000 yen

【Homepage address】 http://www.sanken.osaka-u.ac.jp/labs/mec/index2.html