RESEARCH ACTIVITIES V
Department of Applied Molecular Science

V-A Molecular Design and Functions of Photoactive and Spin-Active Supramolecular Assemblies

To achieve photosynthesis with a totally artificial system is a supreme challenge in science and a dream of molecular scientist. In nature, plants and photosynthetic bacteria depend on photosynthesis utilizing elaborate chromophore arrays to trap solar energy, followed by an efficient energy transfer to the reaction center. Although there have been many efforts to design molecular systems for light-harvesting, they usually surfer from inadequate energy transfer efficiency. Synthetic macromolecules have attracted attention as potential photosynthetic antennae, since they can be incorporated and organized. However, examples thus far reported are generally derived from linear-chain polymers, which, unlike biological macromolecules, can adopt ill-defined morphologies, many of which lead to complicated photochemical events associated with intra- and interchain interactions. Moreover, broad molecular weight distribution and uncontrolled structures inherent in linear chain synthetic polymers, make it difficult to develop meaningful correlation between their structures and photochemical functions.

In this project, we are focusing on development of novel nanomaterials for the exploitation of new functions and properties through molecular design and programmed self-assembly. Especially, creation of novel nanomaterials exhibiting high capability of controlling photoinduced energy transfer and photoinduced electron transfer is one of important missions.

In relation to the above project, we are intended to exploit spatially well-defined dendritic macromolecules for highly controlled arrays of supramolecular and macromolecular metallo–complexes with the goal of developing unique functions that are impossible with small molecules. In detail, we aim for demonstration of principles for molecular design of spin-active nanomaterials, realization of photo-induced spin transition and control of spin state in confined space, and creation of functional nanomaterials for future-generation spin devices.

V-A-1 Molecular Design of Light-Harvesting Antennae

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[*Dendritic Polymers* (in Japanese), NTS, p. 2–21 (2005)]

In the present chapter, we highlight our recent efforts to construct several new bioinspired dendrimers and their self-organization by focusing attention on structure–function relationships.