【Grant-in-Aid for Scientific Research(S)】
Science and Engineering (Chemistry)

Title of Project : Creation of Supramolecular Complex Systems based on Dynamic Chemistry

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Research Area : Chemistry

Keyword : Supramolecular Complex

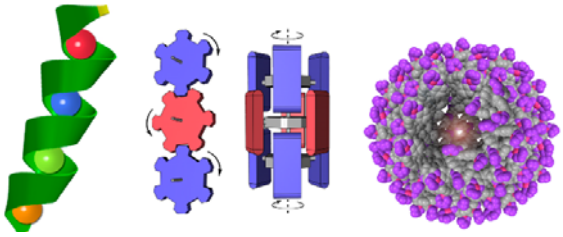
【Purpose and Background of the Research】

A novel supramolecular function is created by precise synthesis of "components" and quantitative design of "bonding". Interactions working between the components allow complex functions as well as dynamic changes in their number, orientation, sequence, and relative positions. Hence, these components should have bonding formation to create functions. In this regard, it is quite important and challenging from such viewpoints to make multicomponent supramolecular cooperation systems, that is, to exploit an excellent tool for making molecular cooperation functions by dynamic control of various interactions and expedient sequencing of multicomponents. This study aims at rational synthesis of organic components for 10 nm-scale multicomponent self-assembly and developing supramolecular cooperation systems that allow "energy transfer", "motional transmission", and "molecular transfer and transportation".

【Research Methods】

This study includes the construction of supermolecules through a self-assembly protocols, precise analyses of the structures and functions of the constructs, and an extension to nanoscopic molecular systems by means of molecular design, supramolecular synthesis, various spectroscopic analyses, and so on.

(1) Array programming of molecules and ions: nano-wires, hetero metal array, etc.
(2) Nano- to submicron-sized dynamic spaces: dynamic giant capsules, nano-drop, etc.
(3) Molecular machines for cooperation systems: molecular crank, photo-driven molecular motors, etc.



【Expected Research Achievements and Scientific Significance】

This study aims at developing our original supramolecular cooperation systems with respect to "programming", "transformation", and "cooperation" based on bio-inspired programming molecules, molecular motional devices, and dynamic nano-capsules that we have developed. With respect to these molecular architectures, our approach will be directed towards sequence programming of functional supermolecules, long-distance motional transmission systems, and molecular transportation systems. Such approaches would provide a useful strategy for hierarchical construction of supramolecular systems. Moreover, it is highly expected that their sizes would range from 10 nm- to submicron-scales which cover boundary areas of the bottom-up and top-down processes. This study would create a wide range of spin-off effects in the fields not only of coordination chemistry but also of supramolecular chemistry, materials science, catalytic chemistry, and nanobiotechnology.

【Publications Relevant to the Project】

・A Discrete Self-Assembled Metal Array in Artificial DNA, K. Tanaka, T. Kato, M. Shionoya et al., *Science 299*, 1212-1213 (2003).
・Ranging Correlated Motion (1.5 nm) of Two Coaxially Arranged Rotors Mediated by Helix Inversion of a Supramolecular Transmitter, S. Hiraoka, M. Shiro, M. Shionoya et al., *J. Am. Chem. Soc. 130*, 9089-9098 (2008).
・A Self-Assembled Organic Capsule Formed from the Union of Six Haxagram-Shaped Amphiphile Molecules, S. Hiraoka, K. Harano, M. Shiro, and M. Shionoya, *J. Am. Chem. Soc. 130*, 14368-14369 (2008).

【Term of Project】 FY2009-2013

【Budget Allocation】 166,000 Thousand Yen

【Homepage Address and Other Contact Information】

http://www.chem.s.u-tokyo.ac.jp/users/bioinorg/index.html