Programming Spatial Arrangements and Specific Dynamic Functions of MetalComplexes using Artificial Ligands with Multi-Binding Sites

Mitsuhiko SHIONOYA

(The University of Tokyo, Graduate School of Science, Professor)

【Outline of survey】

In research fields directed towards the construction of novel materialsat the atomic and molecular levels, the most universal and pressing subjectis to make a quantitative plan for their spatio-temporal arrangements. Namely, programming molecules with information on the atomic and molecular arrangements are indispensable to the realization of high-order functions based ontheir specific arrangements. Programming molecules, to which the information of "number, sequence, and direction" of ions or molecules can be input as desired, could lead to the establishment of novel principles and techniques applicable to atomic and molecular arrangements. Such a system is precisely realized only in life.This study aims at designing and synthesizing biomolecular or completely artificial ligands that are precisely programmed for the spatial arrangements of metal ions, self-assembling metal complexes as programmed, and investigating their specific properties and dynamic functions based on the arrangements. In this study, we create innovative principles and techniques for material-construction leading interdisciplinary fields such as supramolecular chemistry, materials science, and molecular medical science.

【Expected results】

When we construct programming ligands with multi-metal binding sites that can bear the information on the "number, sequence, and direction" of assembled metal ions, a great deal of novel findings on principles and techniqueswould be obtained for atomic and molecular arrangements. Specifically, we aim at constructing, at the atomoc and molecular levels, functionalized metal-assembled complexes (molecular wire), molecular motional devices (molecularball bearings and gears), and molecular medical devices (artificial geneticalphabets, precise labeling of biomacromolecules) that take full advantage of the properties of metal ions.

【References by the principal researcher】

(1) A Discrete Self-Assembled Metal Array in Artificial DNAK. Tanaka, A. Tengeiji, T. Kato, N. Toyama, and M. ShionoyaScience 299, 1212-1213 (2003).

(2) Heterotopic Assemblage of Two Different Disk-Shaped Ligands through Trinuclear Silver(I) Complexation: Ligand Exchange-Driven Molecular MotionS. Hiraoka, M. Shiro, and M. ShionoyaJ. Am. Chem. Soc. 126, 1214-1218 (2004) (highlighted in Nature, 427, 597 (2004): " Molecular merry-go-round" in News and Views).

【Term of project】 FY 2004 — 2008

【Budget allocation】 89,200,000 yen

【Homepage address】 http://www.chem.s.u-tokyo.ac.jp/~bioinorg/index.html