【Grant-in-Aid for Scientific Research (S)】

Science and Engineering (Chemistry)

Title of Project : Hierarchal Control of Carbon Cluster Organization and their Function

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Research Project Number : 15H05754 Researcher Number : 00134809
Research Area : Organic Chemistry
Keyword : Physical Organic Chemistry, Self-organization

【Purpose and Background of the Research】

Structure determination and design/synthesis of molecules are the two classical paradigms of organic chemistry. With the research fields of organic chemistry expanded so much, it has become imperative to gain space temporal control of molecular events, as well as to control the synthesis.

On the basis of the PI's previous achievements in the field of DNA/RNA delivery and organic solar cell research, this project focuses on the hierarchal control of the solution and solid state chemistry including time evolution of the structures of molecules and molecular assemblies, keeping in mind as a goal the design and synthesis of compounds possessing important biological and materials functions. In doing so, we focus on the diverse functional activities of carbon cluster compounds possessing pi-conjugated systems that we have long focused on, deepen our understanding of their space temporal control, and develop their biomedical and industrial applications.

【Research Methods】

Functional carbon cluster materials such as fullerene, porphyrin, bridged conjugated systems form stable association complexes because of their structural rigidity and small entropy change. Their hierarchal control is therefore relatively straightforward, while their chemical, physical, and biological activity are quite high. These are the reasons why we have chosen such compounds for the present studies. We will form 1–3 dimensional organizations in solution and solid, form micelles and vesicles as well as nanoparticles, in order to elucidate the mechanism of their formation. The findings will be exploited for drug delivery, bioimaging and organic laser and organoelectronic devices.

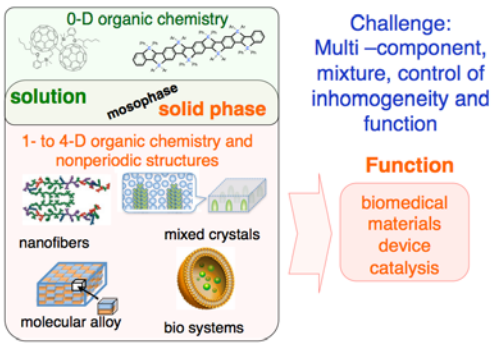

Fig. 1 New Paradigm on Organic Chemistry

【Expected Research Achievements and Scientific Significance】

As summarized in Figure 2, hierarchal control of molecular assemblies of functional carbon clusters not only provides solutions to the societal issues that the world is facing, but also addresses new scientific problems that go beyond the conventional regime of organic chemistry.

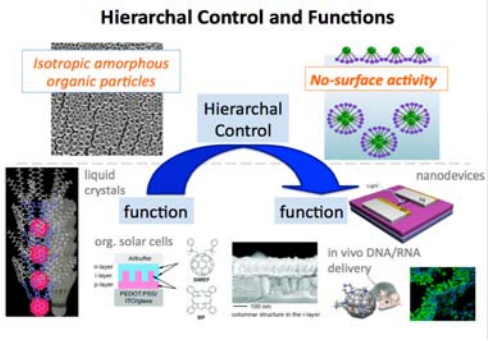

Fig. 2 Hierarchal Control and Functions

【Publications Relevant to the Project】

・ siRNA Delivery Targeting to the Lung via Agglutination-Induced Accumulation and Clearance of Cationic Tetraamino Fullerene, K. Minami, K. Okamoto, K. Doi, K. Harano, E. Noiri, E. Nakamura, *Sci.Rep.*, **4**, 4916 (2014).

・ Electron Transfer Through Rigid Organic Molecular Wires Enhanced By Electronic and Electron-Vibration Coupling, J. Sukegawa, C. Schubert, X. Zhu, H. Tsuji, D. M. Guldi, E. Nakamura, *Nat. Chem.*, **6**, 899-905 (2014).

【Term of Project】 FY2015-2019
【Budget Allocation】 126,600 Thousand Yen

【Homepage Address and Other Contact Information】

http://www.chem.s.u-tokyo.ac.jp/users/common/NakamuraLab.html