Title of Project : "Fusion Materials: Creative Development of Materials and Exploration of Their Function through Molecular Control"

Term of Project : FY2010-2014

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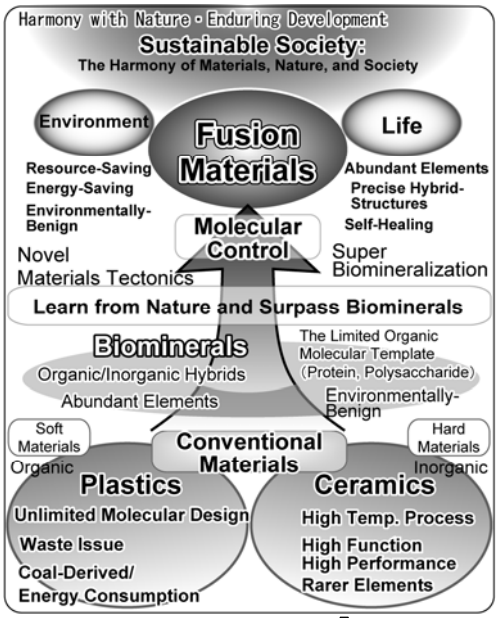
【Purpose of the Research Project】

This project focuses on the innovation of new research area for materials synthesis in coming generation. We aim to create a sustainable society where materials are in harmony with environment. Highly functional, environmentally friendly materials will be produced through energy/resource-saving processes. Here, a "fusion" of organic molecules and inorganic substances is taken place as a new approach.

Biomineralization is one of the attractive strategies of materials synthesis, which are found in nature. Sophisticated organic-inorganic hybrid materials with excellent properties are produced in biomineralization as in the forms of teeth, bones, seashells and exoskeletons. "Molecular control" is the key in this process, where biomolecules precisely control the crystallization of inorganic substances. In this project, environmentally friendly hybrid materials that are comparable to nature-made materials will be synthesized by learning from biomineralization. We also pursue a synthesis of new materials that overcome the limit of nature-made materials. This will be realized by fusing functional inorganic materials with state-of-the-art organic ones, which are developed by the leading scientists here in Japan in the fields of supramolecular, self-assembled molecular, and polymer chemistry.



【Content of the Research Project】

Fusion materials that surpass conventional organic, polymer, and ceramic materials will be synthesized by fusing organic and inorganic, soft and hard, or dynamic and static characteristics. "Molecular control" is a process in which biomolecules control the formation of biominerals such as bones, teeth and seashells. Based on this molecular control processing, we construct fusion materials by using resources that are abundant in nature. "Environmentally friendly structural materials" and "dynamic functional materials" are the two main targets to be obtained.

For this purpose, a variety of scientific fields including organic chemistry, polymer chemistry, inorganic chemistry, physics, biology, and engineering will be fused to create new materials science, although their fields have been independently developed so far. Three research teams are organized in this project: "the molecular control team (A01)" who explores base technology to construct fusion materials through molecular control, and "the structure construction team (A02)" and "the function exploration team (A03)", who develop the base technologies to create practical materials by using the findings provided from the A01 team.

【Expected Research Achievements】

This project develops a base technology of materials synthesis learning from nature. Environmentally friendly materials will be synthesized from the fusion technology between organic and inorganic substances. Functional materials (target functions: energy, biomedical, optical, and sensing etc.) are also constructed by fusing functional inorganic nanocrystals that possess electronic and optical properties and rationally-designed liquid crystals, gels, polymers, and supramolecular materials which show dynamic functions. New scientific areas for the production of structural/functional fusion materials will be generated in this project. The fusion materials constructed from heterogeneous substances through molecular control is environmentally friendly and highly functionalized. This realizes a sustainable society where materials are in harmony with nature.

【Key Words】

Self-Organization, Hybrid Materials, Functional Polymers, Environmentally Friendly Materials, Fusion Materials, Energy-Saving Process, Resource-Saving, Green-Innovation

【Homepage Address】

http://fusion-materials.t.u-tokyo.ac.jp