【Abstract of 2011 Grant - in - Aid for Scientific Research on Innovative Areas
(Research in a proposed research area)】

Biological Science

Title of Project : Spying minority in biological phenomena -Toward bridging dynamics between individuals and ensemble precesses-

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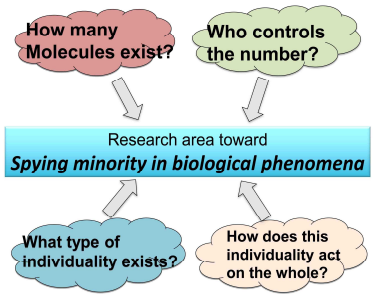
【Purpose of the Research Project】

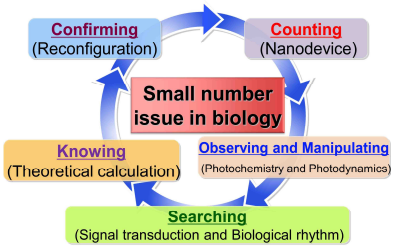
The "cooperative" functioning of a nanosystem composed of a small number of elemental molecules can be considered as a vital phenomenon in living system. However, no previous study has analyzed the elementary process of cooperation among small groups of molecules (minority molecules) in live cells. As a result, there is no information on the approaches to induce extremely high levels of cooperation among these molecules. Cooperative reactions among these small groups of molecules contribute to output stabilization; conversely, the output can also lose stability because of a lack of cooperation between these molecules. The equivocal nature of these reactions may be responsible for the operating stability of macroscopic life systems across hierarchies and may also be indirectly responsible for partial operating instability. Therefore, this equivocal behavior is considered to be extremely important in understanding the operating principles of living systems. However, there are no theories describing the reactions of these minority molecules in cells, and no techniques have been developed to manipulate and measure the intracellular behaviors of these minority molecules. In this research area, we have prepared a biological system composed of minority molecules, and conducted research to construct a theory that can describe the reactions among minority molecules.



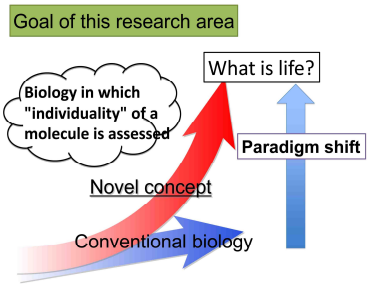
【Content of the Research Project】

In this research area, we study chemical reaction systems composed of a small number of elemental molecules that function neither as individual molecules nor as a part of a majority group. By combining the principles of optical microscopy, microelectromechanical systems (MEMS) technology, fluorescent physical chemistry, synthetic organic chemistry, protein engineering, cell biology, systems biology, and mathematical science, we developed a new field of research called "minority biology."

【 Expected Research Achievements and Scientific Significance】



"What is life" is fundamental question in bioscience, and are difficult to explain using conventional scientific approaches. From our studies, we expect a paradigm shift to occur not only in biology but also in other scientific fields such as physics and chemistry. The new concepts derived from our study may provide important information and facilitate the development of the basic technology necessary for artificially synthesizing biological nanomachines with extremely high energy-utilization efficiency, which will be required worldwide in the future.



【Key Words】

System of minority molecules: A reaction system composed of a few tens of molecules with significant levels of discreteness.

【Term of Project】 FY2011-2015

【Budget Allocation】 1,191,800 Thousand Yen

【Homepage Address and Other Contact Information】

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