【Grant - in - Aid for Scientific Research on Innovative Areas(Research in a proposed research area)】
Science and Engineering

Title of Project : Chemical Approaches for Miscellaneous / Crowding Live Systems

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【Purpose of the Research Project】

Live cells and tissues are multimolecular crowding biosystems consisting of many kinds of biological molecules densely condensed in the closed small spaces. However, conventional biochemical researches ignored such complicated environments where biological molecules reside, and most experiments have been conducted in a purified and diluted solution. Therefore, there are concerns that the obtained results are discrepant with the real functions of biomolecules working in life systems, and also the artificial probes or modulators selected from the pure systems often cannot function in natural biological systems. The purpose of our research project is to establish new chemical approaches available for functional analysis and artificial regulation of biological molecules in the multimolecular crowding biosystems. Accumulating cutting-edge findings from a broad range of research fields (chemical biology, synthetic biology, biophysical chemistry, nano-bioengineering, etc.), we aim to quantitatively describe the multimolecular crowding biosystems and to devise new molecules and methods, which contribute to innovate on bioimaging, drug discovery and disease diagnosis. We envision that our researches could create a new trend for biofunctional chemistry.

【Content of the Research Project】

This research project consists of three teams (A01 – A03) to promote individual researches on their specific topics. Meanwhile, the project highly encourages collaborative researches between the teams. A01 team focuses on design and synthesis of artificial probes and modulators for analyzing and regulating biomolecules available in cells and tissues. A02 team focuses on quantitative analysis and description of multimolecular crowding biosystems based on biophysical and computational chemistry. A03 team focuses on creation of new nanobio-devices for analyzing and diagnosing specific biological molecules (biomarkers) in cells and tissues.
This project also plans to establish Center for Integrated Biomolecular Chemistry (CIBIC) as a hub that underpins and promotes collaborative research between the joining members.

【Expected Research Achievements and Scientific Significance】

Development of artificial probes, sensors and modulators capable of visualizing and regulating biological systems will lead to figure out their new functions and unknown interactive networks in live cell systems (chemical biology research). Quantitative and precise description of multimolecular crowding biosystems will facilitate the rational explanation of such new findings and also greatly accelerate the rational design of functional molecules useful in the crowding biosystems. From the viewpoint of fundamental science, these approaches will promote comprehensive understanding of living cells and organisms as multimolecular crowding systems, which allows for constructing tight and strong bridges between biology and chemistry. Great progress in our research project will also bring technical innovation in precise bio-imaging and highly efficient drug discovery. The innovative nanobio-devices designed by our tools and parameters are expected to provide new methodologies applicable to highly sensitive and rapid medical diagnosis in crude tissues and *in vivo*. Ultimately, establishment of such new chemistry for living systems would contribute to many aspects of progress in life science, life chemistry and medical engineering of Japan.

【Key Words】

Chemical Biology : Chemical research to uncover structure and function of biological molecules and their network systems by exploiting molecular probe and modulator.
Multimolecular crowding biosystems : Biological environments where a variety of biomolecules such as protein, DNA, sugar, ions and small molecules etc., densely exist in a small space.
Nanobio-divice : nano- or microfabricated devices (such as microsensor tip) capable of analyzing a trace of biological molecules with high sensitivity.

【Term of Project】 FY2017-2021

【Budget Allocation】 1,215,500 Thousand Yen

【Homepage Address and Other Contact Information】

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