Title of Project : Multi-dimensional fluorescence live imaging of cellular functions and molecular activities

Term of Project : FY2010-2014

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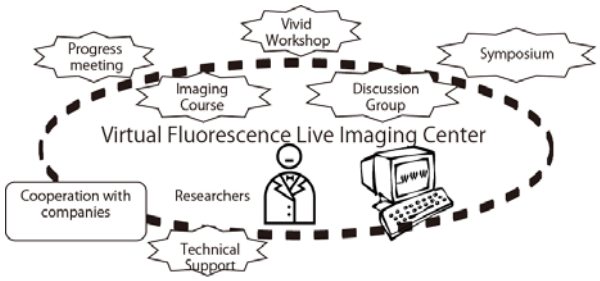
【Purpose of the Research Project】

As represented by the Nobel Prize in 2008, recent progress in the fluorescence imaging is extremely rapid. Fluorescence proteins with various properties have been developed to yield fluorescence biosensors based on the new principles. These novel techniques have led to the visualization of cell functions such as cell cycle and activities of signaling molecules, which were able to study only by biochemical techniques. The rapid progress in fluorescence imaging owes also to the advancement of fluorescence microscopy. For example, two-photon excitation microscopy has enabled real time imaging of the cells and tissues in living organism. Therefore, we can declare the revolution of fluorescence imaging, when researchers are able to observe the living organism in multiple dimensions, time, space, and function. This research area will combine the experts of fluorescence biosensors and fluorescence microscopy and the young cell biologists to create novel research area named "Vivid Life Science".

【Content of the Research Project】

One of the main purposes of this research area is to advocate the advanced techniques of multi-dimensional fluorescence imaging among researchers of life science. We will organize "Virtual imaging center" to accelerate collaboration among the researchers belonging to this research area.

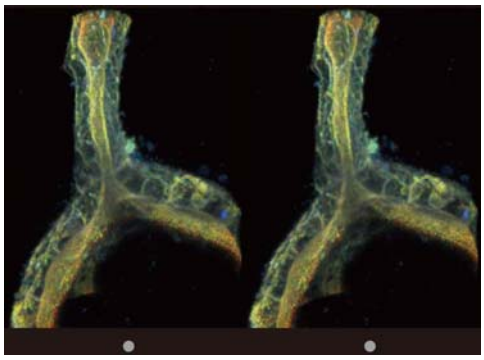


In the research group A01 "Advancement of fluorescence biosensor and live cell imaging", we aim at developing new technologies and improvement of hitherto developed technologies of fluorescence live imaging. In the research group A02 "Investigation of life with multi-dimensional fluorescence live imaging", we will shed new light on biology by taking advantage of the advanced fluorescence live imaging.

【Expected Research Achievements】

We will develop new fluorescence biosensors of cell cycle, apoptosis, and stemness, new FRET biosensors for the application to two-photon excitation microscopy, and new two-photon excitation microscopes for the imaging of deep tissues with less damage. These new technologies will visualize the cell function in three-dimensional tissues, leading to the comprehension of various aspects of life. For example, we expect breakthrough in the field of cancer, immunological disorders, and lifestyle diseases.

Stereogram of Cdc42 activity in renal tubule cells



【Key Words】

Two-photon excitation microscopy: By illuminating a tiny volume with
FRET imaging: An imaging technique to visualize the activity/concentration of the signaling molecules or second messengers with biosensors based on Förster resonance energy transfer.

【Homepage Address】

http://www.lif.kyoto-u.ac.jp/imaging/ (Japanese only)