【Integrated Science and Innovative Science（New multidisciplinary fields）】

Innovative High-speed AFM for Elucidating Vital Phenomena

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【Outline of survey】

"Dynamics" is one of intrinsic properties of biological molecules. Thus far, measurements of dynamic phenomena, which take place at the molecular and cellular levels, have mainly been performed by fluorescence microscopy. Although new fluorescence microscopy that breaks the diffraction limit has already been materialized, in principle it is never able to visualize biological molecules themselves. We have developed a high-speed atomic force microscope and succeeded in capturing dynamic behaviors of protein molecules on video. The functional mechanisms of some protein systems have been revealed by the imaging. However, with the current high-speed AFM, the tip-sample interaction force is small but not negligible to very delicate samples. As the membranes of live cells are extremely soft, they are deformed by the interaction force, and therefore, molecular processes occurring thereon cannot be imaged. Imaging intracellular structures is even more beyond the microscope. In the present study, we extend the capability of our high-speed AFM to develop a high-sensitive/high-speed AFM, a high-speed non-contact AFM, and a high-speed diaphano-AFM.

【Expected results】

By the aforementioned development, it will become possible to observe dynamic processes of very delicate samples without disturbing their functions. It will enable observing dynamic biomolecular processes occurring on live cell membranes, such as dynamic behaviors of receptors as they bind to ligands and opening/closing of ionic channels. In addition, it will enable observing dynamic behaviors of intracellular organelles such as nuclei and Golgi bodies. By materializing non-contact imaging, the imaging rate will be increased higher than the current rate of 30-60 ms/frame.

【References by the principal researcher】

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- T. Ando, T. Uchihashi, N. Kodera, A. Miyagi, R. Nakakita, H. Yamashita, and M. Sakashita, High-speed atomic force microscopy for studying dynamic behavior of protein molecules at work. *Jpn. J. Appl. Phys*. **45**(3B):1897-1903 (2006).

【Term of project】 FY2008－2012	【Budget allocation】 **149,800,000 yen** (direct cost)

【Homepage address】 http://www.s.kanazawa-u.ac.jp/phys/biophys/index.htm