Keynote

NANOSCALE PHYSICAL AND CHEMICAL PROBES FOR CELL ODYSSEY

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Strong motivation to improve quality of life puts molecular biology of cells at the center of biological and medical sciences. For example, reliability of gene therapy and drug delivery system would greatly depend on detailed knowledge about the intra- and inter-cellular chemical reactions. Furthermore, cells, due to their ultimately self-organized and highly functionalized structures to sense and process various signals, are attractive materials to be studied to open a new realm of sciences and technologies.

I present our multiple-scanning-probe microscope (MPSPM) which has originally been developed for measuring electrical properties of nanomaterials [1], such as nanofilms [2], nanowires [3], and so on. For such measurements, macroscopic electrodes connected to such nanomaterials are not required. So it would be appropriate to use MPSPM to investigate signal transfer and transduction in a living cell (cell odyssey: see figure).

In this talk, new types of physical and chemical probes which are specially developed for probing electrical and chemical signals locally in liquid will be introduced. For example, a bundle of carbon nanotubes are attached onto a metal probe and further coated with insulating materials. Such probes have been repeatedly inserted into a cell and measured electrical signals through the cell. We have also developed a metal oxide nanorod probe which can detect molecules via enhanced intensities of Raman scattering signals. The sensitivity of this nanorod probe can detect even a single molecule nearby the probe apex. Other types of probes have been developed for measuring local proton concentration, i.e., pH value.

References:

[1] M. Aono. C.-S. Jiang, T. Nakayama, et al., OYO Buturi (in Japanese), **67**(1998)1361.
[2] J. Onoe, T. Nakayama, M. Aono, and T. Hara, Appl. Phys. Lett., **82**(2003)595-597.
[3] O. Kubo, Y. Shingaya, M. Nakaya, M. Aono and T. Nakayama, Appl. Phys. Lett., **88** (2006)254101-1-3.

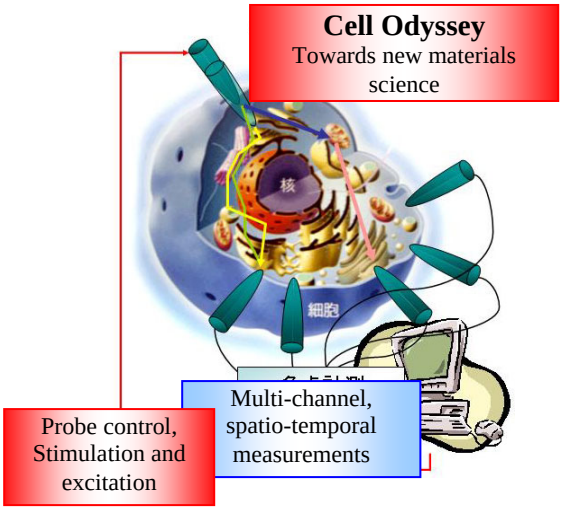

Figure: Cell odyssey (MPSPM measurements of a cell) to investigate functions of a single cell.