heterogeneous due to stochastic effects in gene expression. Many theoretical studies on gene expression fluctuation approximate the effect of growth and cell division simply assuming that protein decay rate is the sum of degradation and dilution rates. The global effects of macro parameters, such as growth and cell division, on intracellular gene expression fluctuation, however, remain largely unknown. To find the relation between growth and fluctuation in *Escherichia coli*, we developed a new microfluidic device that allows rigorous environmental control and tracking of a large number of individual cells for hundreds of generations. We thereby measured an inheritable character, defined here as a decay in the auto-correlation function of gene expression level, under several growth conditions. As a result, it has been revealed that the decay of auto-correlation function is slow; the correlation decreases only to ~0.8 per average doubling time. We also found that a decrease in growth rate increases the decay-time of the auto-correlation function of expression fluctuation in single cells. Such “growth rate-dependent memory preservation” may underlie the universality of cellular phenotypic adaptation to various environmental changes.

2J1536 大腸菌における表現型遺伝性と抗生物質への適応の一細胞計測
Single-Cell Level Observation of Phenotypic Heredity and Adaptation to Antibiotic in *Escherichia coli*

Takashi Nozoe¹, Reiko Okura¹, Yuichi Wakamoto^{1,2} (¹*Grad. Sch. Arts and Sci., Univ. Tokyo*, ²*JST PREST*)

In a clonal cell population, each cell has different individuality, which might be inherited to next generation. In fact, it is known that not only dose protein copy number fluctuate temporally and from cell to cell, but also its autocorrelation decays slowly over a few generations in *Escherichia coli*. In this sense, the gene expression exhibits “primitive heredity”, which may lead to phenotypic adaptation in a lethal environment, such as bacterial persistence, when the copy number of some protein in each cell strongly affects its survival. In order to clarify such role of stochastic gene expression in the context of adaptation, the authors constructed an *E. coli* strain that expresses the fusion of antibiotic resistant and fluorescent proteins from an inducible promoter, and observed the strain in two ways. At first, we confirmed that the survivability of the strain in antibiotic exposure was higher than that of the wild type and correlated with the induction levels. Next, we simultaneously observed the growth and the fluorescent level of the strain using a microfluidic device, and successfully detected a small number of survivors among a clonal cell population that proliferated after the withdrawal of the antibiotic. To directly verify the role of “primitive heredity” experimentally, we also constructed a modified strain that expresses destabilized fusion proteins and confirmed that its autocorrelation of protein copy number decays faster. We will discuss the usability of the single-cell level observation system described above.

2J1548 心筋を模倣した自動振動ゲルによるソフトロボットの創製
Devel of novel autonomous doft robot

Yusuke Hara¹, Shingo Maeda², Shuji Hashimoto³ (¹*AIST*, ²*Shibaura Univ.*, ³*Waseda Univ.*)

We introduce autonomous gel actuators driven by chemical energy. The polymer gels prepared here have cyclic chemical reaction networks. With a cyclic reaction, the polymer gels generate periodical motion. The periodic motion of the gel is produced by the chemical energy of the oscillatory Belousov-Zhabotinsky (BZ) reaction. We have succeeded in making synthetic polymer gel move autonomously like a living organism. This experimental fact represents the great possibility of the soft robot.

2J1612 V字型電極アレイを用いた誘電泳動力による微粒子の連続的濃縮分離
Continuous Concentration and Separation of Microparticles Using Dielectrophoretic Force in a V-Shaped Electrode Array

Masahito Hayashi¹, Hyonchol Kim¹, Hideyuki Terazono¹, Akihiro Hattori¹, Kenji Yasuda^{1,2} (¹*Yasuda "On-chip Molecular Cell Phenomics" Project, KAST*, ²*Inst. Biomat. Bioeng., Tokyo Med. Dent. Univ.*)

We have proposed and developed the novel principle of a V-shaped electrode array in a microfluidic pathway for continuous-concentration and -separation of particles by dielectrophoretic (DEP) force. The advantage of V-shape microelectrode arrays with a microfluidic flow for cell separation is that whole particles are concentrated into the center of a micropathway independent of the difference in their dielectric constants in the X-Y plane, while the particles are split between the top or bottom of the micropathway in the Z-axis direction

depending on the differences in their dielectric constants and the applied AC frequency. After the application of a sinusoidal AC voltage of 1MHz and 20Vpp, both polystyrene spheres and *Bacillus subtilis* spores were concentrated at the tip of the V-shaped electrode at the center of microfluidic flow in the X-Y plane independent of their dielectric constant differences. They were also split into two directions in the Z-axis, i.e., polystyrene spheres rose to the top, and spores went down to the bottom depending on their dielectric constant differences and were successfully separated in two layered downstreams. The results indicate the potential of V-shaped electrode arrays for simple continuous purification of mixed particles depending on their dielectric constants.

2J1624 非常時の科学コミュニケーション：基礎科学者に何ができるか
Science Communication by Basic Scientists in Crisis Settings
Senkei Umehara^{1,2} (¹*Dept. Sci. Soc., Sci. Commun. Hq., JST*, ²*Grad. Art. Sci., Univ. Tokyo*)

The Great East Japan Earthquake and the following nuclear and radiation accidents represented a milestone in the history of science communication. Trust in science and the scientific community has been challenged; it is not simply due to the insufficient quality and quantity of published data but rather to the confusion about the way of communicating those data as evidence-based, “interpreted” messages at the right timing to the right audience by the right spokespersons. In such crisis settings, knowledge and the capacity of basic scientists tend to be limited and therefore, their roles continue to be unclear. To discuss the roles of scientists in science communication, first the talk will introduce feedback from two past sessions. One is about barriers and motivations for their participation in science communication activities, which was held at the Biophysical Society of Japan Annual Meeting in 2010; the other is about how and to what extent such activities can be carried out by scientists themselves, which was held as a featured session at Science Agora 2010. The talk will then move on to open-ended discussion, mainly focusing on how to maximize the contribution of basic scientists to society at large, and how trust in science can be (re-)gained through improved communication.

This talk is intended for an interactive case study among the audience, with the presenter providing some noteworthy pieces of information. Open-minded scientists at any career stage will be welcomed.

2J1636 Fabrication of gold nanoparticles in cells by laser-induced photoreduction

Kentaro Mochizuki¹, Nicholas Isaac Smith² (¹*AppliedPhysics, GradSch, Univ. Osaka*, ²*Biophotonics lab, IFRc, Univ.Osaka*)

Noble metal nanoparticles have attracted a great deal of attention in optical and medical fields due to their unique optical properties, notably the Localized Surface Plasmon Resonance (LSPR). When introduced in live cells, metal nanoparticles are known to retain this unique property. The electromagnetic field induced around nanoparticles by LSPR enables Surface Enhanced Raman Scattering (SERS) of chemical constituents in cells and photothermal therapy of cancer cells. Accordingly, different techniques to introduce metal nanoparticles into cells were investigated in recent years.

In our group, one unique technique was investigated involving the fabrication of gold nanoparticles inside cells by laser-induced photoreduction. HeLa cells were irradiated with 532 nm CW laser after incubation in gold ion solution, resulting in the fabrication of gold nanoparticles in the desired position. After the fabrication process, the appearance of black points in laser-irradiated areas in cells was confirmed in the bright field image. These black points were due to the laser-induced reaction of gold ions since no changes were observed in cells without gold ions under the same laser irradiation process. Indeed, the existence of photoreduced gold nanoparticles in cells was shown by Transmission Electron Microscopy and Energy Dispersive X-ray analysis. Those gold nanoparticles had 5~15 nm diameter and appeared close to each other but not touching inside the cells.

14:00~17:00 K会場／Room K

細胞生物学的課題 2

Cell biology 2

2K1412 活性化後に起こる Gα2 と cAMP 受容体間相互作用の検証
Novel mechanism of interaction between active G protein alpha subunit and GPCR