

# Biological and Human Information Laboratory

Dept. of Interdisciplinary Science  
Grad. School of Science and Engineering

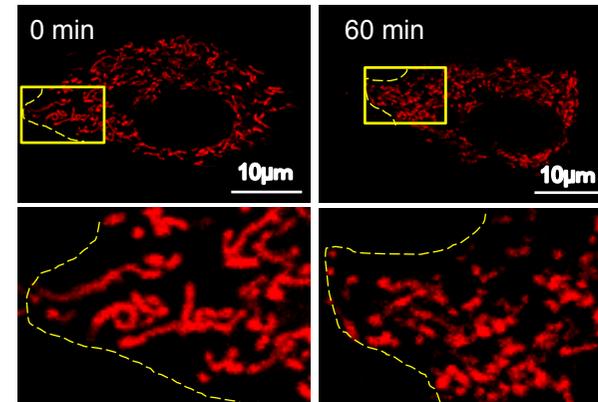
Professor TADA Shigeru, *Ph. D*  
Associate Professor TSUKAMOTO Akira, *Ph. D*

Graduate School Alumni FUJITA Takayuki, *Master's Program '11*  
SHINMURA Aya, *Master's Program '14*  
TAKAHASHI Toru, *Master's Program '16*  
BABA Megumi, *Master's Program '16*

# Current Research Areas of Interest

## (1) Morphological dynamics of mitochondria in cells under cyclic stretch (TSUKAMOTO)

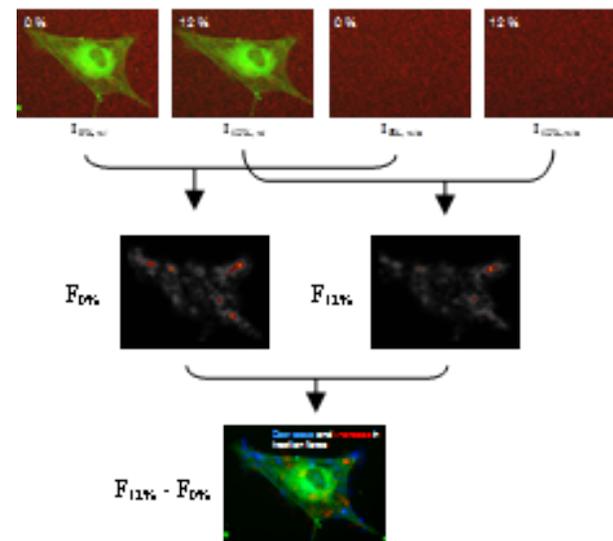
Cyclic-stretch is a mechanical stimulation exerted on cells due to arterial pulsation, and induces cells to generate mitochondrial reactive oxygen species (ROS). In addition, mitochondria generate ROS in association with changes in their morphology. Thus, changes in the morphology of mitochondria could play a role in the mitochondrial ROS generation in cells under cyclic stretch. However, it is still unclear whether the morphology of mitochondria is altered by the stimulation of cyclic-stretch. In our Laboratory, in order to reply the above question, we are investigating the morphological dynamics of mitochondria in Human aortic endothelial cells under the exposure of uniaxial cyclic-stretch by using a time-lapse imaging technique..



Morphological changes of mitochondria in cells under cyclic-stretch (Left) Onset of cyclic-stretch (right) 60min later

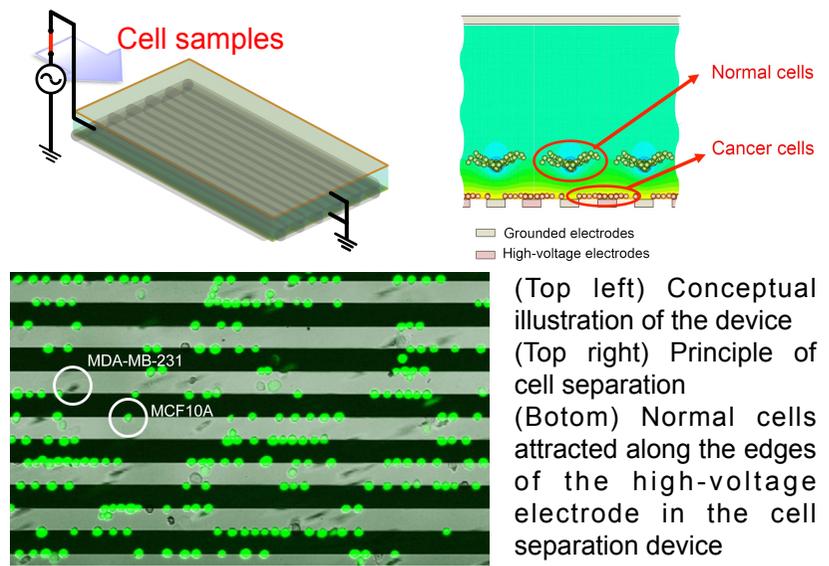
## (2) Bio-transport Physical signal transduction by cells (TSUKAMOTO)

Physical forces span multiple cells during embryogenesis to generate complicated tissues. This function of physical forces could be involved in other generating and regenerating processes in tissues, however, it remain elusive. In our lab, we measure physical forces which span multiple cells and single cells with fluorescence imaging to understand how physical forces involve in those processes. We believe our study contribute to understanding embryogenesis more in detail and regenerating processes in our body, i.e. adult.



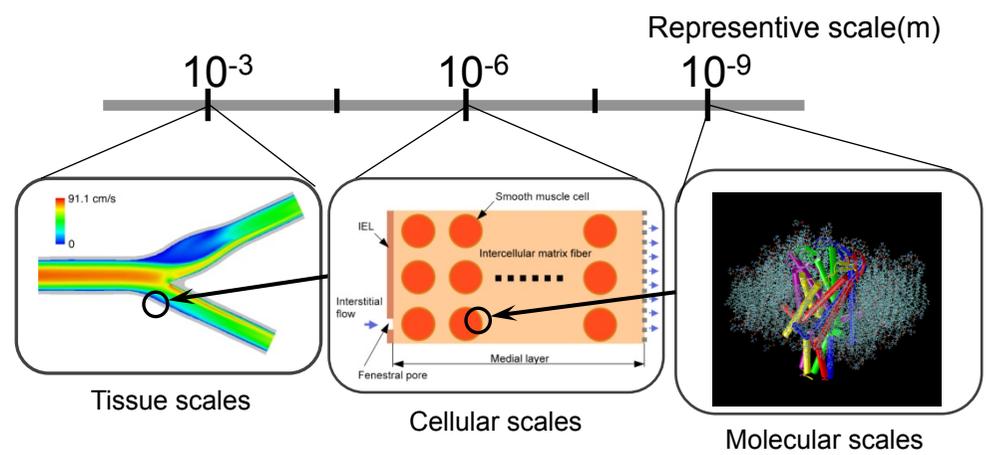
### (3) Dielectrophoretic Separation of Cells Using a Nonuniform AC Electric Field (TADA)

Separation of specific cells from a cell population is one of the crucial processes in many biomedical applications. Dielectrophoresis (DEP) is effective and widely used techniques for separating biological species. In our laboratory, a simple and effective technique is proposed to separate normal cells from cancerous cells by DEP. A three-dimensional nonuniform AC electric field established in the whole volume of a flow channel is utilized to separate cells. Numerical simulation model was developed and the experiment using mammalian cells were performed to evaluate the optimum condition for designing a high throughput DEP cell separation device.



### (4) Bio-transport multi-scale modeling and computer analysis (TADA)

In the biological systems, coupled mechanisms interact across multiple spatial and temporal scales: from the cell to the whole organism, from nanoseconds to years. All these scales can neither be probed by a single experimental technique, nor modeled using a single phenomenological approach. Our research group is trying to achieve a multi-scale description of dynamic processes associated bio-molecular assemblies as well as cooperative interactions of multiple biological entities such as channel protein and cell membrane of particular relevance to cell signaling pathways implicated in atherosclerotic lesions.



Multi-scale modeling of Bio-transport system dynamics