

## Research topics for graduate students for 2025

### Associate Professor Hidehiro Oana

Department of Mechanical Engineering

Does not accept IME students this year



#### Research Topics

In our laboratory, we are engaged in the development of manipulation technologies for single cells and single molecules based on microfabrication techniques. With this technology, we explore the stimulation and response measurement of individual cells and biomolecules, their control as functional and engineering components, and their utilization. Through this research, we aim to gain insights into cellular life activities that could not be obtained through conventional research methods and to provide entirely new methods for modifying cellular functions. We seek to contribute to basic life science and medical fields through these research findings, as well as to the creation of new industries utilizing cells with advanced functions, thereby contributing to the realization of a sustainable society.

#### 1. Development of single-cell analysis technology [1]

Understanding the biological significance of the differences between cells of the same type, elucidating disease mechanisms, and developing new treatments require technologies to examine the DNA state and gene expression of each cell in detail. We are developing technology to extract chromosomes from individual cells in microchannels created through microfabrication, measuring genetic information and epigenetic modifications on individual chromosomes.

#### 2. Development of high-yield cell function modification/regulation technology [2]

We are developing technology using microdevices with specific microstructures to inject predetermined amounts of substances into individual cells. We aim to achieve high-throughput, parallel techniques for endowing cells with new functions or controlling the timing of function expression. These technologies are expected to contribute not only to gene therapy, cell medicine, and regenerative medicine but also to the creation of new industries using highly designed and manufactured cells.

#### Articles Related to Research Topics

[1] Kiyonori Noda and Hidehiro Oana, Toward single-cell epigenome analysis: A microfluidic device for isolating, stretching, and imaging individual chromosomes, *Sensors and Actuators B: Chemical*, **394**, 134462 (2023). [DOI: 10.1016/j.snb.2023.134462]

[2] K. O. Okeyo, R. Hiyaji, H. Oana, A single-cell surgery microfluidic device for transplanting tumor cytoplasm into dendritic cells without nuclei mixing, *Biotechnology Journal*, **18**, e2200135 (2023). [DOI: 10.1002/biot.202200135]

**Lab. Web page:** <http://www.bntl.t.u-tokyo.ac.jp>