# FUJII LAB.

# [Applied Microfluidic Systems]

Center for International Research on Integrative Biomedical Systems

Microfluidics, cell engineering, underwater technology and molecular engineering

Precision Engineering / Bioengineering

http://www.microfluidics.iis.u-tokyo.ac.jp/

# Applied Microfluidic Systems

# From Deep-Sea Application to Cell Engineering

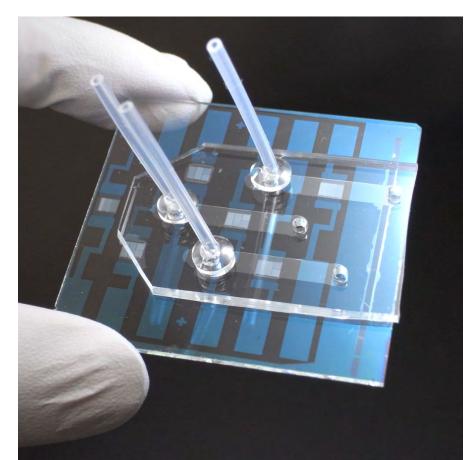
#### Soft actuator

We developed an unique soft actuator based on "Microhydraulics" which uses microfluidic channels and integrated pumps to create 3D motion.



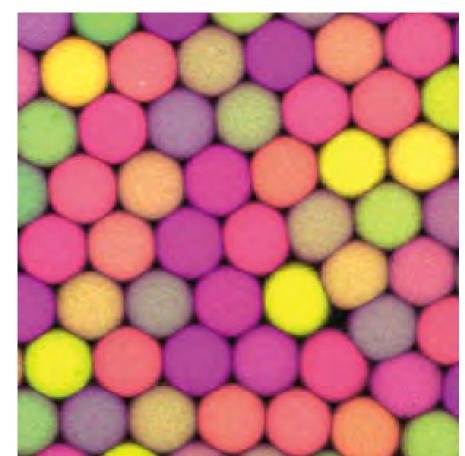
### Single cell analysis

We have developed a microwell array device for parallelized single cell analysis using electrostatic functions including dielectrophoresis and electroporation.



#### Biochemical networks

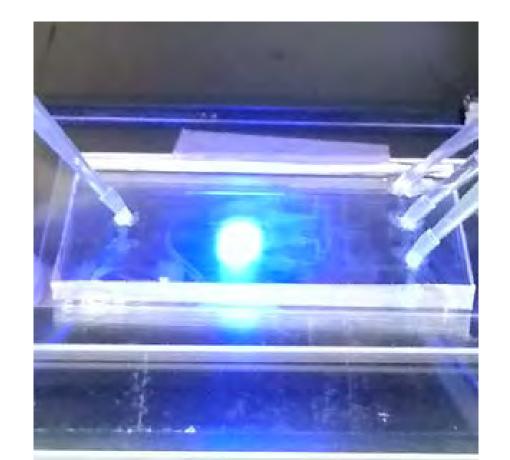
Targeting a behavior and encoding it in DNA-based circuits, a bistable memory circuit that can be switched back and forth was demonstrated successfully.



Microhydraulics

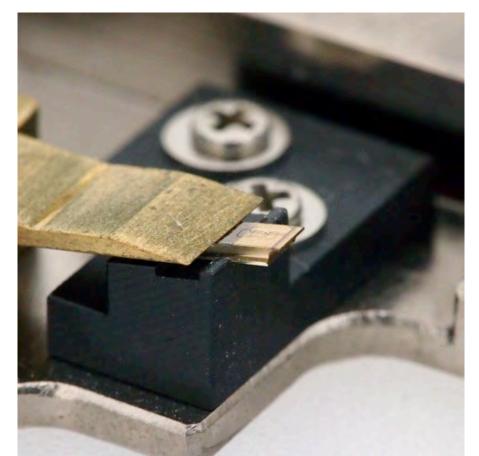
#### Control of gene expression We are developing a novel system

enabling temporal control of gene expression by combining optogenetics and microfluidics.



#### Underwater AFM

A compact AFM system, which is mountable on underwater vehicles, is studied to investigate the nanoscopic samples in deep sea and in situ.



Microfluidic control Flow measurement Fluid mechanics

Biochemical network Nanofluidic device Molecular analysis

Molecule

Engineering

Single Cell

Microfluidics

Analysis

Deep Sea

Soft actuator

Integration of components

Application to robotics

in situ Measurement

Cell

Deep sea exploration Engineering

> Cell culture system Medical application Cell chip, cell device

### Miniaturization & Integration

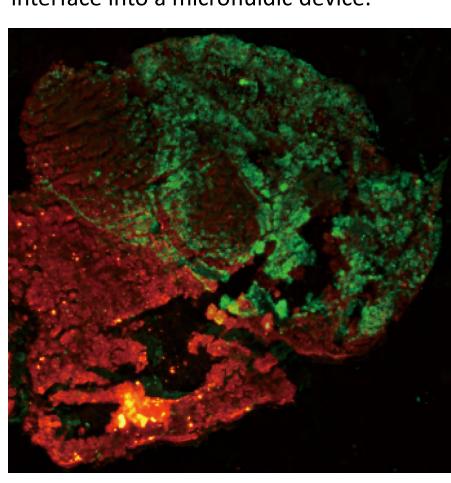
- High accuracy, High efficiency
- Low cost, Mass production
- Controlled Microenvironment

# Microfabrication techniques

- ■MEMS/NEMS
- ■Photolithography
- ■PDMS Molding

## Cell / tissue showcasing

A cell/tissue showcase system which regulates fluidic/adhesive conditions is developed by integrating artificial biointerface into a microfluidic device.



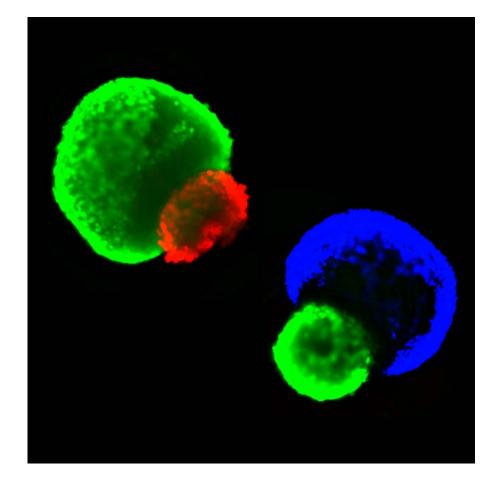
## Compartmentalized culture

Single-cell level handling

Integrated devices

Rare cell analysis

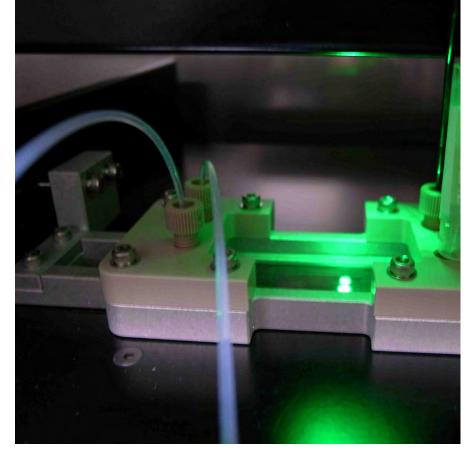
A compartmentalized culture system for cell aggregate has been developed for spatially controlled differentiation of iPS cells or anticancer drug evaluation.



# Cell culture system

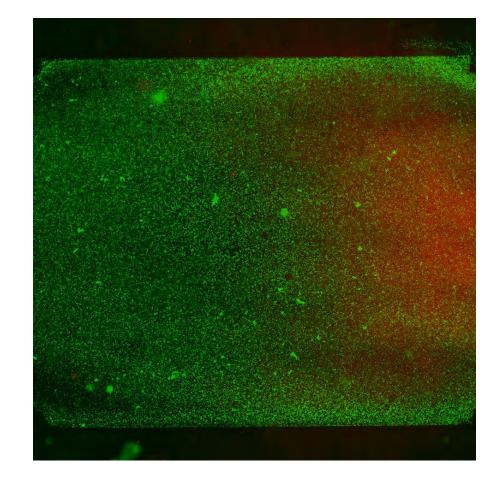
A microfluidic cell culture system which enables dynamic control of a signal molecule concentration has been developed for cell signaling study.

Microfluidic Device



### Liver cell culture

We are developing a microfluidic device which allows generation and visualization of oxygen gradients to understand hepatic metabolism.



# CTC analysis

**Environmental measuring** 

Highly-integrated system

We perform single-cell PCR and immunostaining of circulating tumor cells (CTCs) to show usefulness in diagnosis or treatment of cancer.

