

Rapid injection of fluorescent sensor into a cell by local mechanical stimulus using optical tweezers



NAGOYA UNIVERSITY

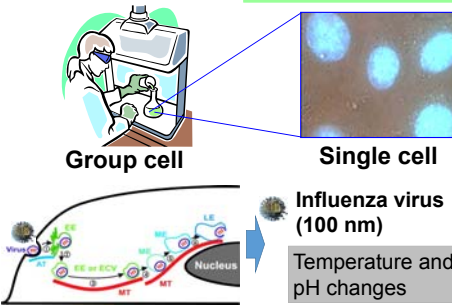
○ Hengjun Liu, Hisataka Maruyama, Taisuke Masuda, Fumihito Arai
Department of Micro-Nano Systems Engineering, Nagoya University, Japan



Vibration stimulus for accelerating sensor injection

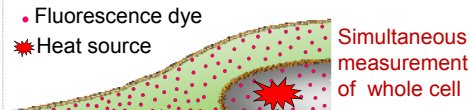
Background

Analysis of virus infected cell

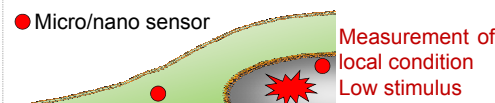


Intracellular measurement

1. Staining cell by fluorescence dye



2. Injection of sensor into cell



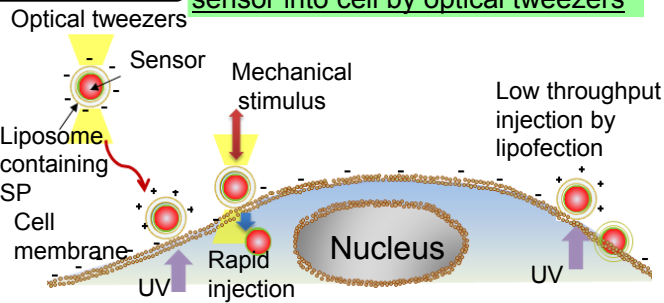
The methods of sensor injection

Injection Method	Stanporation	Endocytosis	Lipofection
Schematic image			
Injection to individual cell	Yes	No	No
Damage to cell	Yes	No	No
Rapid injection	Yes	No	No

Rapid and selective injection of sensor with low damage to cell is required

Concept

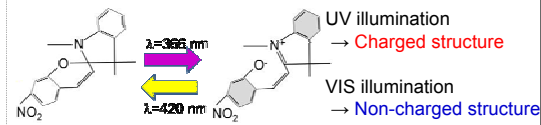
Selective and rapid injection of sensor into cell by optical tweezers



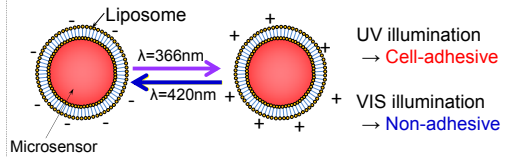
Injection process

- 1). Preparation of liposome containing single sensor
- 2). Selective adhesion of liposome to cell membrane by optically-induced charge control
- 3). Rapid injection of sensor using vibration stimulus by optical tweezers

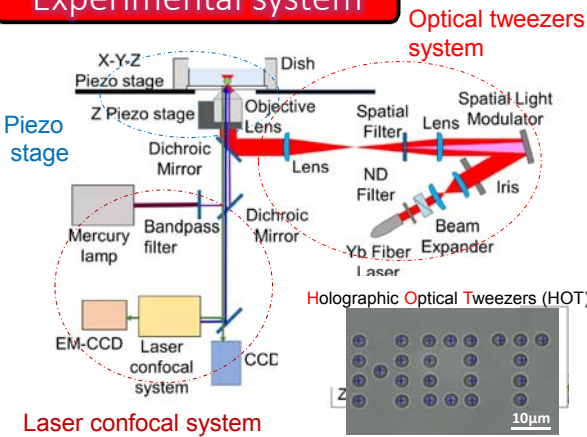
Photoreaction of Spiropyran (SP)



Optically-induced control of liposome



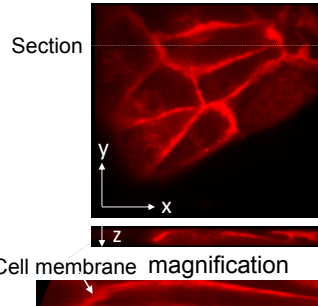
Experimental system



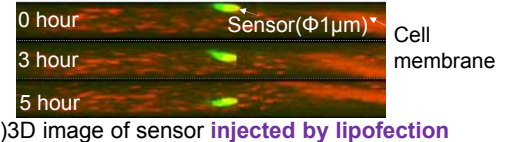
Results

Rapid injection of individual sensor by optical tweezers

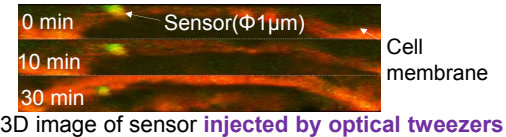
Cell membrane is stained by Cell Mask



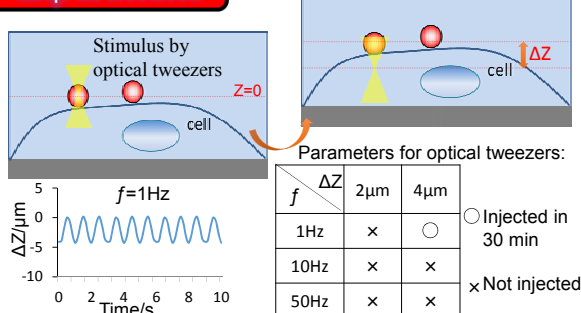
Without vibration stimulus



With vibration stimulus



Experiment



Conclusions

We succeeded to adhere the sensor to a cell selectively through optical control. We also achieved rapid sensor injection (approximately 30 min) into the cell by applying local mechanical stimulus using optical tweezers with amplitude of 4 μm and frequency of 1 Hz.

