Laser-Assist Rapid Injection of Nano sensor into Cell

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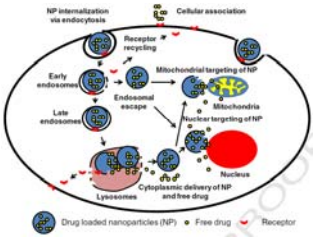
局所加熱で細胞導入率100%，導入時間2秒を達成!!

Background

Intracellular analysis in micro/nano scale



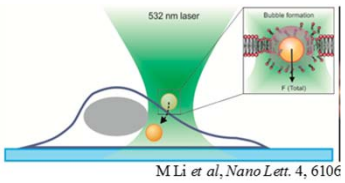
Series of infection and proliferation of influenza birus

Intracellular physiological conditions (pH, temp. etc.) is considered to change dramatically.

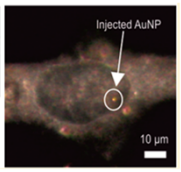
Ex) Infection of influenza virus
Virus proliferation in the nucleus

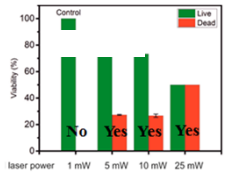
Increase of temperature
Decrease of temperature

Selective Injection of Nanosensor into Cell



M Li *et al*, *Nano Lett.* 4, 6106





Optical injection of metal nanobead

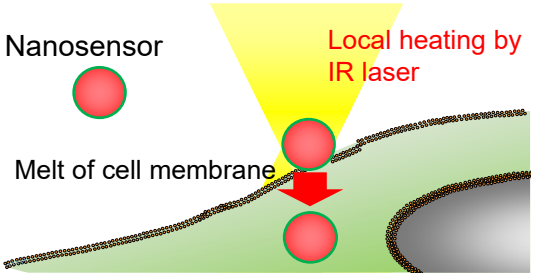
Injection of Au bead (80 nm)

Cell Survival rate: 73%

How to achieve Low-invasive Injection?

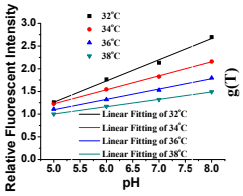
Concept

Nanosensor injection using Local heating

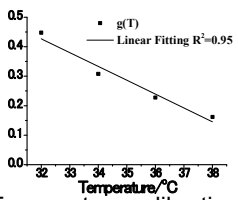


pH and Temperature sensor

- Amino-coated magnetic PS beads
  Diameter: 750 nm, 300 nm
- FITC: pH sensitive



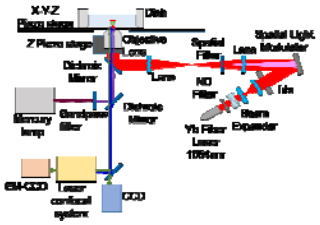
pH calibration



Temperature calibration

Experimental System

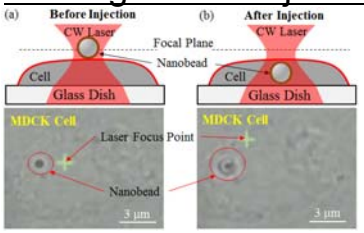
- NIR laser (1064 nm)
- Confocal fluorescence system

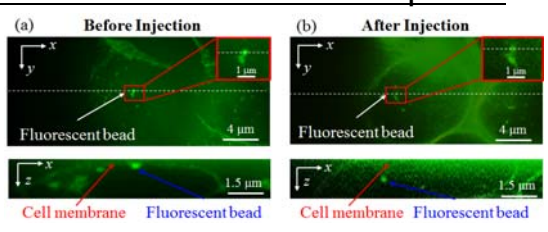


Temperature calibration

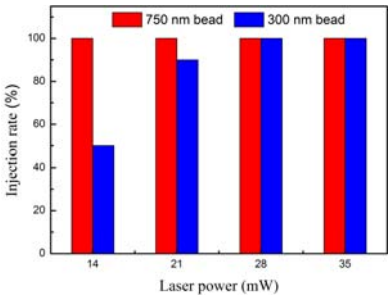
Experiments

Investigation of injection rate and time with laser power



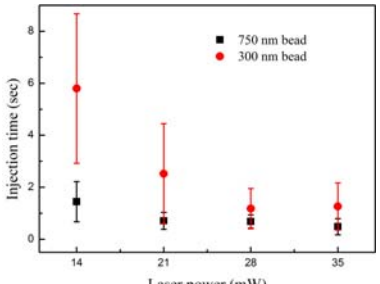


Cell number: 10 cells in each condition



Laser power vs Injection rate

Cell number: 10 cells in each condition



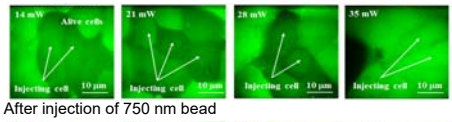
Laser power vs Injection time

Injection rate
100 %

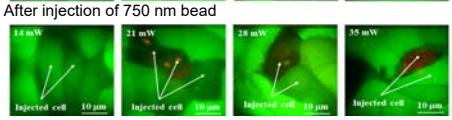
Injection time
2 s

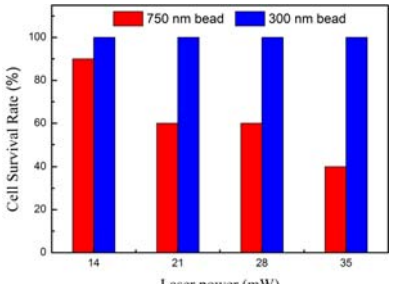
Cell viability test after injection

Before injection of 750 nm bead



After injection of 750 nm bead





Laser power vs Cell survival rate

Survival rate
100 %

300 nm
28 mW

Conclusions

1. Selective and low-invasive injection of nanosensor into cell using laser heating was developed.
2. Rapid injection (2 s) and High throughput injection (100%) were achieved using ϕ300 nm bead.

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Reference
J. Zhong, H. Liu, H. Maruyama, T. Masuda, F. Arai, Continuous-wave laser-assisted injection of single magnetic nanobeads into living cells, Sensors & Actuators: B. Chemical, 230, pp. 298-305, 2016.