Multi-fluorescent particle sensor for optical sensing of pH and temperature of cell

In situ measurement of pH and Temp. by multi-fluorescent sensor

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Background

Analysis of Conditional changes of virus infected cell

Group cell

Heat

pH

Single cell

Conditional changes

Influenza virus

(100 nm)

Temperature and pH changes

Cellular measurement

1. Staining cell by fluorescence dye

- Fluorescence dye
  - Heat source

2. Fluorescent sensor based on microspheres

- Micro/nano sensor

- Measurement of local condition
- Low stimulus

Advantages of fluorescent sensor based on microsphere

- Direct measurement of local condition
- Easy to be operate
- No damage to cell
- Low stimulus to cell

Our study is focused on the fabrication of fluorescent sensor

Concept

- Microspheres: Amino-Poly-styrene beads (Ps) (1μm in diameter)
- Indicators
  - Rhodamine B: Temperature sensitive (Ex. 561nm)
  - FITC: PH and Temperature sensitive (Ex. 488nm)

Experimental system

- Halogen Lamp
- Sample Chamber
- Objective Lens
- X-Y Stage
- Switchable Mirror
- Confocal unit
- EM-CCD
- Confocal microscopy: Ti-E (Nikon)
- Laser confocal scanning unit: CSU-X1
- Laser wavelength: 488/561 nm
- EM-CCD: Fluorescence detection
- Incubation chamber: ZILCOS

Results

Fluorescence responses to pH and Temp.

- FITC
- Rhodamine B

Temperature compensation of pH calibration

- Without temperature compensation
- With temperature compensation

Fluorescent endurance to surrounding ionic strength

- K⁺: 0, 100, 200, 300 mM
- Na⁺: 0, 100, 200, 300 mM

Equation 1

ΔF_{FITC} = f(T) × ΔPH

Equation 2

f(T) = -0.0499T + 2.04

Equation 3

ΔPH = \frac{ΔF_{FITC}}{-0.0499T + 2.04}

Equation 4

ΔF_{Rhod B} = -0.034 × ΔT

Conclusions

- The synthesized multi-fluorescent sensor which is based on microspheres can respond to both temperature and pH.
- The sensor possesses good stability, reversibility and endurance to surrounding ionic strength.
- The pH accuracy of our sensor has increased from 1.5 to 0.18 after temperature compensation.

Reference

- Hengjun Liu, et al, “Multi-fluorescent particle sensor for optical sensing of pH and temperature of cell”, 2PO8, 28th Cheminas

Acknowledgements:

This work has been supported by CREST (Core Research for Evolutional Science and Technology) of JST (Japan. Science and Technology Corporation).