

Micro Enzymatic Activity Measurement

INTRODUCTION

Enzyme . Fig. 1
Enzyme 가 .
가
enzyme . Thermal device
enzyme 가
가 .
enzyme thermal device 가 .
β-Galactosidase enzyme chip
enzyme .

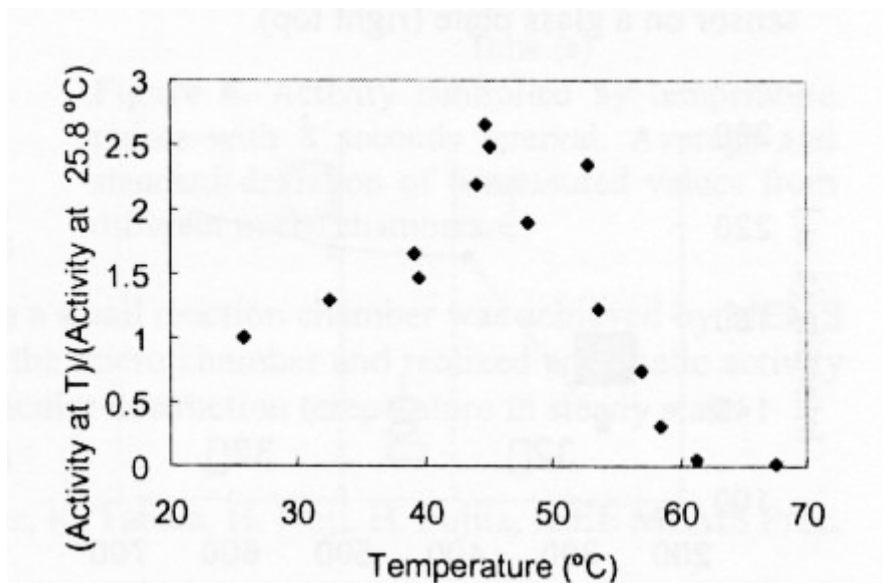


Fig. 1. Temperature dependent activity of β-Galactosidase by bulk experiment. Exposing at temperature T for 2 minutes.

EXPERIMENTAL

400 μm thermo resistive chip

array가 chip 1 ~ 110 fL

enzyme

array Ni가 PDMS

(Fig. 2). β -Galactosidase FDG (Fluoresceindi- β -D-Galactopyranoside) 가

pH가 7.5 100 mM phosphate buffer 400 μM FDG 37 nM

β -Galactosidase Ni가

PDMS PDMS가

(Fig. 3). ± 2 $^{\circ}\text{C}$

1.4 60 fL β -

Galactosidase 37 nM 1300 enzyme

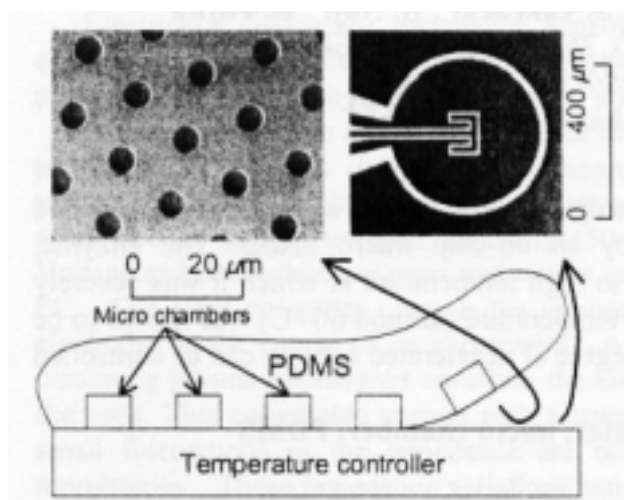


Fig. 2. Schematics of the temperature controlled micro chamber array (bottom). SEM image of patterned PDMS sheet (left top). Optical microscope view of integrated micro heater and micro thermo sensor on a glass plate (right top).

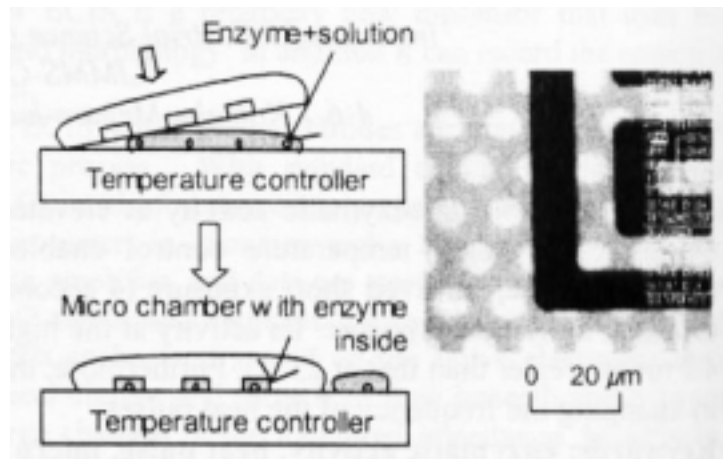


Fig. 3. Process to confine enzyme in micro chambers (left); the solution with enzyme was poured on the temperature controlled glass plate and a patterned PDMS sheet was placed on top to enclose them into micro chambers. Microscope view of fluorescent intensity of enzymatic activity inside the micro chambers (right).

RESULTS

enzyme

32 °C 60 °C 2

가 (Fig. 4). enzyme 2

enzyme . 4

(Fig. 5) enzyme 가 (Fig. 6).

enzyme

가 . Enzyme 가

가 . 8 가 44

가 가 . Enzyme

$$\frac{4V_{60} + 44V_{23}}{48V_{23}} = 1.27 \leftrightarrow \frac{V_{60}}{V_{23}} = 4.20 \quad (1)$$

$$\frac{4V_{60} + 8V_{23}}{12V_{23}} = 2.08 \leftrightarrow \frac{V_{60}}{V_{23}} = 4.23 \quad (2)$$

V_{60} 60 °C 가 V_{23} 23 °C 가 .
 4.23, 4.20 가가
 . 가
 . 60 °C β -Galactosidase 23 °C 4.2

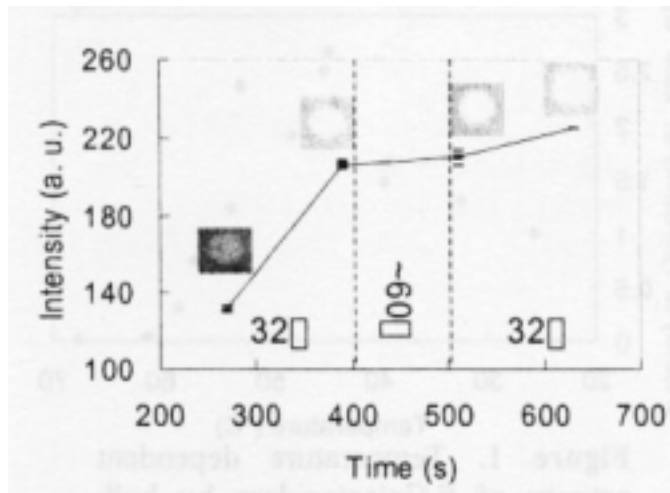


Fig. 4. Intensity-Time curve at temperature from 32 °C to around 60 °C and back to 32 °C

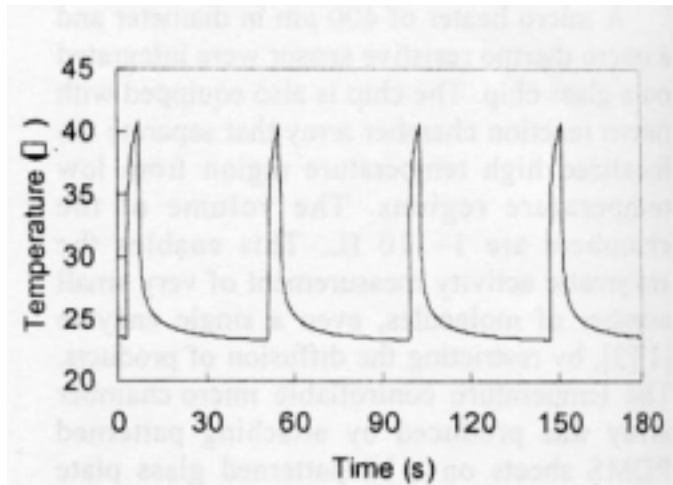


Fig. 5. Temperature pulses induced by the heater measured by integrated thermo sensor

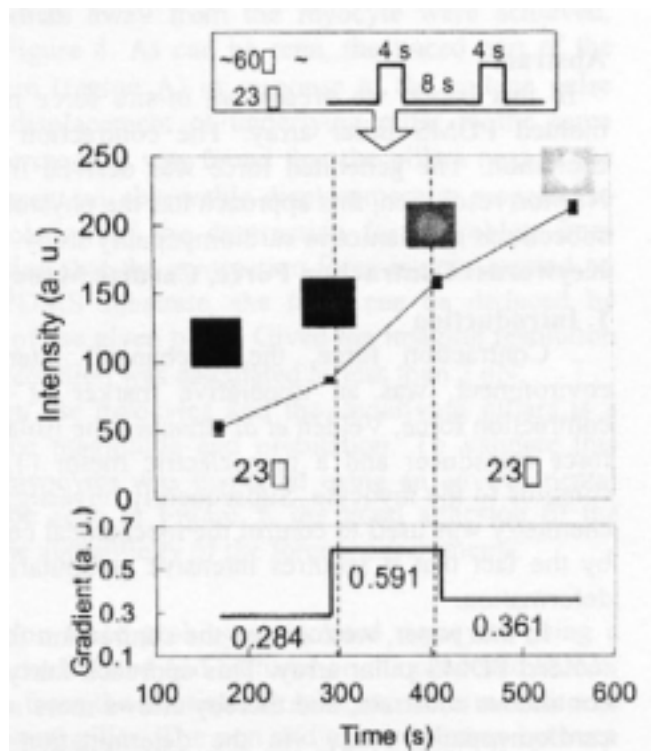


Fig. 6. Activity controlled by temperature pulses with 8 seconds interval. Average and standard deviation of 6 measured values from different micro chambers.

CONCLUSION

Enzyme

chip

chip

enzyme