

Ultra Low Flow Rate Measurement

INTRODUCTION

micro chip

BioMEMS

BioMEMS

BioMEMS device

가 Enzyme

가

BioMEMS device

H_2O_2

enzyme

가

flow cell

H_2O_2

H_2O_2

(Fig. 1)

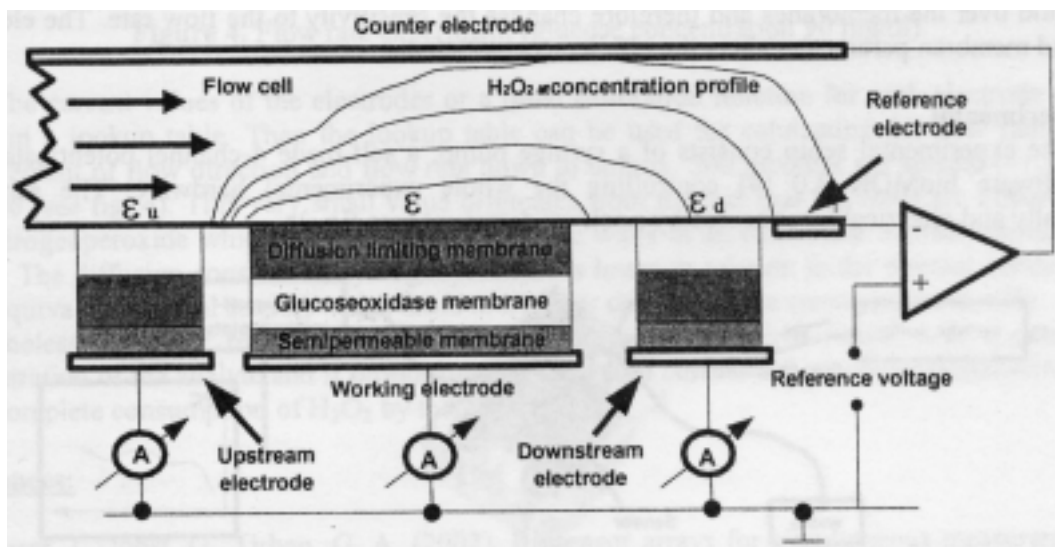


Fig. 1. BioMEMS scheme

THEORY

Glucoseoxidase membrane: $1 \text{ mol glucose} + 1 \text{ mol O}_2 \rightarrow 1 \text{ mol H}_2\text{O}_2$

H_2O_2 detected at the working electrode: $\varepsilon(v) \text{ mol H}_2\text{O}_2 \rightarrow \varepsilon(v) \text{ mol O}_2$

Emission of H_2O_2 to the flow cell : $[1 - \varepsilon(v)] \text{ mol H}_2\text{O}_2$

H_2O_2 detected at the upstream electrode: $[1 - \varepsilon(v)][\varepsilon_u(v)] \text{ mol H}_2\text{O}_2 \rightarrow$

$[1 - \varepsilon(v)][\varepsilon_u(v)] \text{ mol O}_2$

H_2O_2 detected at the downstream electrode: $[1 - \varepsilon(v)][\varepsilon_d(v)] \text{ mol H}_2\text{O}_2 \rightarrow$

$[1 - \varepsilon(v)][\varepsilon_d(v)] \text{ mol O}_2$

total loss of H_2O_2 to the flow cell: $[1 - \varepsilon(v)][1 - \{\varepsilon_d(v) + \varepsilon_u(v)\}] \text{ H}_2\text{O}_2$

$\varepsilon, \varepsilon_d, \varepsilon_u$

v

(Fig. 2)

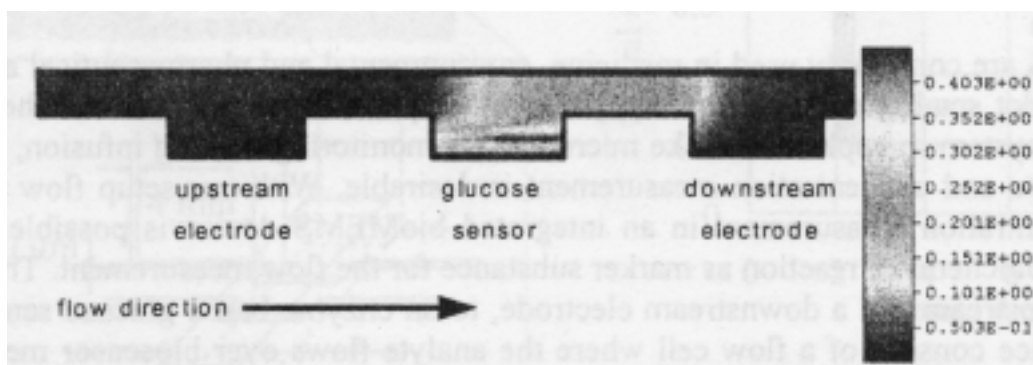


Fig. 2. Numerically simulated H_2O_2 concentration profile

Flow cell , , 가
 . simulation . Flow cell
 가 .

EXPERIMENTAL

syringe , 4 channel potentiostat,
 bioMON software . Fig. 3 .

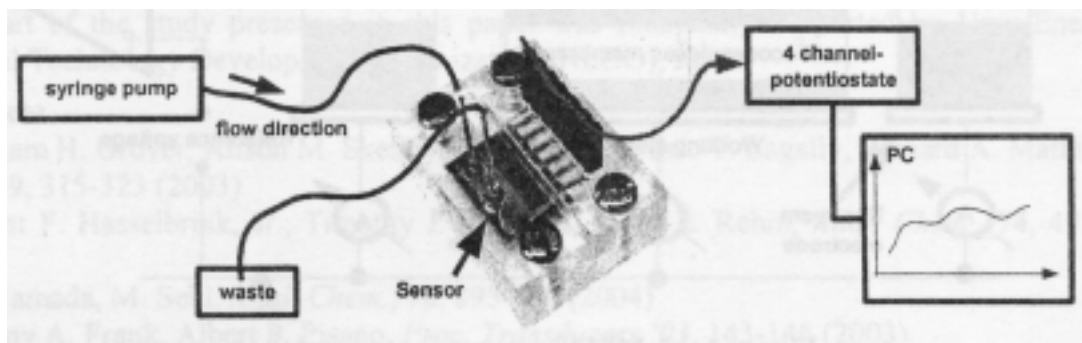


Fig. 3. Experimental setup

IMTEK -Sensors microtechnology

. Flow cell
 가 250 nl 0.05 mm² . 400 μm
 pitch 800 μm .

RESULTS

Fig. 4 data . Fig. 4

가 .

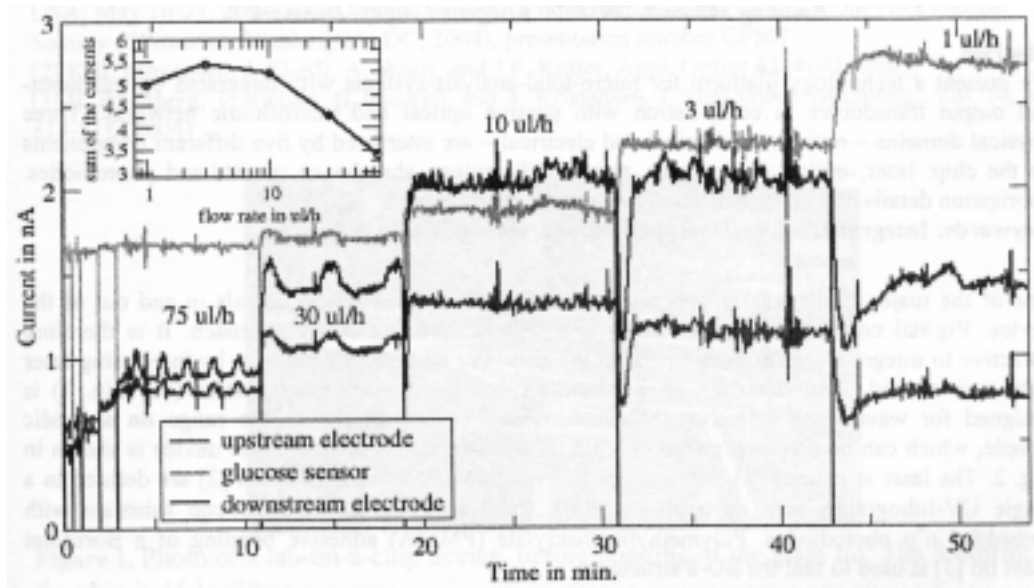


Fig. 4. Flow rate experiment (glucose concentration 90 mg/dl)

table .

table .

300 picoliter

per second ($\sim 1 \mu\text{L/h}$) .

hydrogenperoxide가

가 . Hydrogenperoxide

가