

## On-Chip Microdialysis System with Flow-Through Glucose Sensing Capabilities

Yi-Cheng Hsieh, Ph.D.,<sup>1</sup> and Jeffrey D. Zahn, Ph.D.<sup>2</sup>

### Abstract

#### Background:

Microdialysis is a sampling technique based on controlling the mass transfer rate of different-sized molecules across a semipermeable membrane. Because the dialysis process has minimal effects on the surrounding fluid, it is viewed as a tool for continuous monitoring of human metabolites. In diabetes treatment, microdialysis probes have been used as sampling systems coupled to a glucose biosensor but may struggle to obtain high recoveries of analytes, as the sampling housing, probes, and glucose sensors are fabricated as separate pieces and then assembled, resulting in a large dead volume, which limits sensing frequency. An *in situ* combination of a miniaturized microdialysis probe with an integrated glucose sensor could help solve some of these problems.

#### Method:

The system was fabricated by bonding a 6- $\mu\text{m}$ -thick polycarbonate track-etch membrane with 100-nm-diameter pores onto microfluidic channels with the electrochemical glucose sensing electrodes patterned within the microchannels.

#### Results:

*In vitro* experiments demonstrating glucose microdialysis with continuous sensing were conducted. The permeability of glucose to the polycarbonate membrane with a 100-nm-diameter pore size was obtained to be 5.44  $\mu\text{m}/\text{s}$ . Glucose recovery of 99% was observed using this microdialysis system at a perfusion flow rate of 0.5  $\mu\text{l}/\text{min}$ . Experiments monitoring fluctuating glucose concentrations in the time domain at 99% recovery were also performed. The lag time was measured to be 210 seconds with 45 seconds contributed by mass transfer limitations and the rest from dead volume within the experimental setup.

#### Conclusion:

The electrochemical sensing component was able to continuously track concentration changes in the reservoir. This system is expected to have the proper sensitivity to track physiologically relevant concentration changes of glucose with a lag time of less than 1 minute and minimal amplitude reduction for continuous glucose monitoring for diabetes treatment.

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**Author Affiliations:** <sup>1</sup>Department of Bioengineering, Pennsylvania State University, University Park, Pennsylvania; and <sup>2</sup>Department of Biomedical Engineering, Rutgers, The State University of New Jersey, Piscataway, New Jersey

**Abbreviations:** (GOX) glucose oxidase, (ISF) interstitial fluid, (PBS) phosphate-buffered saline, (PDMS) polydimethylsiloxane, (Pt) platinum

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**Corresponding Author:** Jeffrey D. Zahn, Ph.D., Department of Biomedical Engineering, 599 Taylor Road, Room 311, Rutgers, The State University of New Jersey, Piscataway, NJ 08854; email address [jd Zahn@rci.rutgers.edu](mailto:jd Zahn@rci.rutgers.edu)