

# Warren J. Baker Endowment for Excellence in Project-Based Learning Robert D. Koob Endowment for Student Success

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## FINAL REPORT

### I. **Project Title**

Application of Polymer Bound Boronic Acid for Glucose Detection in Printed Microfluidic Devices

### II. **Student(s), Department(s), and Major(s)**

(1) Spencer Schultz, Department of Chemistry and Biochemistry, Polymers and Coatings MS

(2)

(3)

### III. **Faculty Advisor and Department**

Andres Martinez, Department of Chemistry and Biochemistry

### IV. **Cooperating Industry, Agency, Non-Profit, or University Organization(s)**

Brent Summerlin, Department of Chemistry, University of Florida.

### V. **Executive Summary**

The goal of this research project was to develop a simple and quantitative chronometric glucose test on printed, paper-based microfluidic devices using polymer bound boronic acid (PBBA) as the principle reagent for providing selectivity and sensitivity to the assay. Current diagnostic tests rely on enzymes in order to selectively detect glucose. Using PBBA, instead of enzymes, should increase the shelf life of glucose tests as the polymer is not as susceptible to denaturation the same way enzymes are. Spencer spent a week in Florida synthesizing and characterizing the polymer required for the devices. The rest of the project was conducted at Cal Poly, where Spencer focused on optimizing the design of the device. We are working towards a device to measure glucose concentrations in the range of 0.5 to 10 mM using less than 40  $\mu$ L of a liquid sample in a time frame under 30 minutes. While we have demonstrated that the device responds to glucose, we have not yet demonstrated a concentration-dependent response. By optimizing the polymer and the device design, we hope to achieve a functional device in the near future. The results gained from this project will serve as a foundation for further research into the use of non-enzymatic polymer-based assays in printed microfluidic devices.

## VI. Major Accomplishments

- (1) Synthesized and characterized several different polymer bound boronic acid polymers in collaboration with researchers at the University of Florida.
- (2) Designed and fabricated multiple versions of a paper-based microfluidic device for performing the glucose assay.
- (3) Tested two-dimensional and three-dimensional paper-based microfluidic devices for compatibility with the chronometric assay and determined that the three-dimensional device provided results with higher precision.

## VII. Expenditure of Funds

Funds were expended on travel to the University of Florida and supplies and reagents for the project. Expenditures are summarized in the following table:

Item	Amount
Travel:	
Round trip airfare (SLO to Gainesville)	\$561.20
Hotel in Florida (7 nights)	\$541.46
Car rental	\$177.55
Meals	\$300.00
<i>Subtotal</i>	<i>\$1580.21</i>
Supplies & reagents:	
Pipet tips (10 $\mu$ L)	\$302.52
Pipet tips (200 $\mu$ L)	\$302.52
Chlorophenol red	\$133.88
B galactosidase	\$172.52
<i>Subtotal</i>	<i>\$911.44</i>
<b>Total</b>	<b>\$2491.65</b>

## VIII. Impacts to Student's Learning

Spencer gained a wealth of knowledge and experience from this project in the areas of microfluidics and polymer synthesis. He also gained the confidence to pursue a project independently. Spencer found the trip to the University of Florida was very beneficial to his development as a scientist as it allowed him to gain numerous experiences as both a scientific researcher and a graduate student. The trip allowed him to gain valuable experience as a scientific researcher through the collaboration with colleagues at a different academic institution who work in a different area of polymer chemistry that is not represented at Cal Poly. Through this collaboration, he also received experience in communicating his project to other scientists with limited knowledge of diagnostics and device fabrication, but a wealth of experience in polymer synthesis. This project, and specifically the exposure to research at an R1 university, was also inspirational to Spencer and reinforced his desire to pursue a Ph.D. after obtaining his Master's degree from Cal Poly.