Implantable Multi-analyte Electrochemical Sensor Array

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Sensors for continuous monitoring of relevant physiological analytes, such as glucose, lactate, and pyruvate are crucial for diagnostics in emergency and critical care medicine. Current monitoring techniques are not continuous and involve taking blood samples. The current work focuses on developing an electrochemical multi-analyte sensor array for implantation in the body to continuously monitor glucose, lactate, and pyruvate simultaneously.

This sensor measures the current related to the rate of reaction occurring between, for example, glucose and glucose oxidase with an organometallic redox polymer acting as the transport for the electron to the electrode. The first step in sensor fabrication is to use photolithography to develop an electrode array (example seen in Figure 1). Using the electrode array as the platform, sensing elements (redox polymer and enzyme) are incorporated by electrostatic attachment and encapsulation inside a biocompatible poly(ethylene glycol) diacrylate (PEG-DA) hydrogel.

Previous research has shown that these redox polymer-based devices are effective, but in existing sensors the reliability and biocompatibility need improvement. To increase the reliability of the sensor, redundancy will be implemented by the utilization of the array of sensors. Biocompatibility is improved by the use of PEG-DA hydrogels.

The fabricated glucose sensors exhibit a linear response in the biological range and respond to glucose individually and collectively. The fabricated lactate sensors have been shown to have a linear response and have no cross-talk between neighboring electrodes. To monitor multiple analytes, an electrode array similar to the one in the figure below with slight modifications is utilized and incorporates all sensors that have been fabricated in one unit allowing for simultaneous monitoring.

Future and ongoing work for this project includes optimization of the fabricated sensor arrays and *in vivo* studies. For the *in vivo* experiments the fabricated sensors will be tested for viability and reliability in rats.

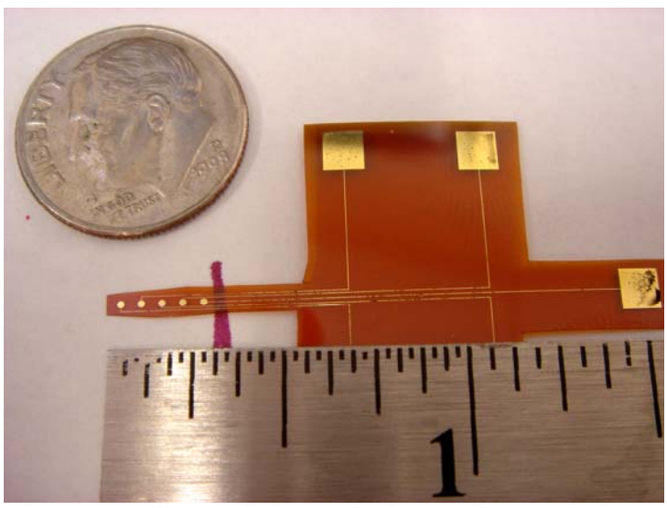

Figure 1: Fabricated Electrode Array where only the part to the left of the line will be inserted into the skin (where the scale is in inches).