Development of a Novel Organic Chemiresistor Sensor for Disease Detection Through Breath: Applied Through a Computational Model

Shiju, Akhil (School: Lawton Chiles High School)

Diseases are diagnosed based on physical attributes that define the disease. Many diseases such as cancer rely on invasive methods such as biopsy for detection. Others are hard to detect early due to lack of signs. Most testing methods are very expensive. The goal of this project was to develop an effective method for disease detection through breath alkanes. In this project, I tested different designs for Chemiresistive sensors to analyze which design is most effective based on Sensitivity, Constancy, Hydrophobic properties, extraneous response, and baseline-saturation resistance range. I constructed the sensor through three different types of coating techniques such as drop-coating, dip-coating, melt-coating on a circuit board. After these coats were applied, copper wires were attached to measure resistance. These sensors were then exposed to different alkane gases. Through testing of the parameters for the sensors, it was determined that Melt coating with a quantity of 0.1 grams of Carbon powder to 0.1 grams of Tetracosane yielded the best results. The next part was to model the sensors ability to detect disease. The two diseases chosen were bronchial carcinoma (patient's breath containing heptane gas elevations) and coronary artery disease (patient's breath containing Pentane elevation). After developing gas concentrations, based on gas chromatography data, from patient's breath, the sensors were exposed to the concentration. Resistance data were then collected for each gas concentration. My sensor was able to model disease breath signature according to statistical calculations, and I am able to identify gas concentrations. A computer model was then developed to represent the probabilities of the diseases occurring based on output generated by the sensors.

Awards Won:

Patent and Trademark Office Society: Second Award of $500