

The Development of a Mechanized Approach to Rapidly and Sensitively Detect and Purify Water Contaminated with Shigella, E. coli, Salmonella, and Cholera through the Use of Carbon-Based Biosensors in Conjunction with Arduino-Controlled Micropipettes

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Waterborne diseases cause more than 3.4 million deaths annually. Yet, conventional detection methods, which many in the developing world cannot afford, can take several days and have detection limits of up to 1,000 CFUs for bacterial pathogens. Thus, the purpose of this study was to engineer sensors that could sensitively and rapidly detect bacterial presence in water and create a mechanized purification unit to sanitize contaminated water. Graphene isolated from graphite and CVD chips were utilized to create 4 specific biosensors through the immobilization of Galactose, Glycerol, Glucose, and Lactate oxidases, that utilized the respiratory cycles of bacteria as a means for bacterial detection. *S. aurantiaca*, *E. aerogenes*, *V. fischeri*, and *E. coli* were used as model organisms for *Salmonella*, *Shigella*, *Cholera*, and *E. coli*, respectively. Biosensors were then tested with 1, 5, and 10 CFUs of bacteria per 100 and 1000 mL of water to assess sensitivity. All four engineered biosensors demonstrated the ability to successfully detect the presence of 1 CFU of the respective bacteria in 1 L of water immediately. A mechanized approach was then taken to purify contaminated water samples through the use of arduino microcontrollers. Using the biosensors as confirmation of successful elimination of bacterial presence, the arduino-controlled system was able to eliminate bacterial presence in a water source. Therefore, these two systems can be used in order to detect at least 1 CFU of the major waterborne pathogens and eliminate bacterial presence in a drinking source in a more rapid, sensitive, and user-friendly manner, which will help in reducing the threat of disease outbreak that exists in the world.

Awards Won:

Second Award of \$2,000

ASU Rob and Melani Walton Sustainability Solutions Service: Award of \$2,500