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Fast, Droplet-based Impedimetric Bacterial Viability Assay Based on Cells' Osmoregulation Response

A rapid, array-formatted sensor utilizes evaporation and conductance measurements to detect bacteria 15 times faster than current methods for applications like food safety, drug screening, and infection diagnosis.

In the process of bacterial sensing assays, detection relies heavily on growth time to observe changes in the physical properties of the growth medium, and therefore, are very time consuming and laborious. Slow detection limits application of these methods for fast and early diagnosis of infections in hospitals. There are fast viability detection techniques, such as molecular-based methods, differentiation based on dielectrophoresis, and light-addressable potentiometric. However these methods require high voltages, large sample volumes, optical labeling and readout systems, and/or PCR machines for sample amplification, which limits their applicability in point-of-care screening. There is a need to develop a more efficient viability detection system.

Bacterial cells are sensitive to osmotic pressure in their external environment, which is proportional to ionic concentration. Researchers at Purdue University have developed a faster detection system that uses evaporation to trigger bacterial cells, thereby causing cell modulated changes in osmotic pressure, which can be detected from the evaporating droplets through conductance. This system allows detection down to approximately 10^4 cells/ml within about 20 minutes, which is a 15-fold improvement compared to current technologies used in detection. Hence, this technology is a fast, real time, array-formatted sensor for biological applications, such as rapid assessment of response time of osmoregulatory proteins, food monitoring, and/or drug screening against multiple pathogens. This can also be integrated with lab-on-chip systems for high throughput screening of pathogens and could potentially be used to determine antibiotic doses for patients.

Advantages:

Technology ID
2015-ALAM-67108

Category
Agriculture, Nutrition, & AgTech/Food Safety & Traceability
Biotechnology & Life Sciences/Analytical & Diagnostic Instrumentation

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-Faster bacterial detection

-Efficient conductance measures for osmotic pressure

-Multiple healthcare and food industry applications

Potential Applications:

-Food safety

-Bacteria detection

TRL: 3

Intellectual Property:

Provisional-Patent, 2015-09-18, United States | Utility Patent, 2016-09-19, United States | CON-Patent, 2020-04-30, United States

Keywords: Bacterial sensing, fast viability detection, osmotic pressure sensing, evaporation-triggered detection, conductance measures, rapid pathogen screening, food monitoring, drug screening, lab-on-chip integration, antibiotic dose determination