388c Rapid Detection of Bacterial Count and Viability in a Microfluidic Device Using Electrical Impedance Spectroscopy

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For a large number of applications in basic, clinical, food, and environmental microbiology, one is interested in detecting the presence of small numbers of bacteria (< 1000 per ml of sample) and in establishing their viability under conditions of interest. Traditional methods for doing so are labor intensive and take a long time (1 day or greater) to provide results.

Electrochemical detection could be used to overcome the disadvantages of tradtitional methods. Bacteria have been known to impart additional capacitance and resistance to the solutions in which they are present. Moreover, as they respire, they break down sugars and complex carbohydrates to species such as lactic acid and carbonic acid (carbon dioxide in solution) that make the media more conductive. However, the combined effects of bacterial number and metabolic activity make typical electrochemical measurements (such as the conductivity of the sample) difficult to interpret – and hence these methods are not very widely used.

In this piece of work, we have built a microfluidic device that allows the sample to be loaded, incubated, and subsequently exposed to multiple antagonists in parallel. We are able to detect the presence of small numbers of bacteria (<1000 per ml) and establish the viability (or lack thereof) of a bacterial strain within six hours using a frequency scan technique that allows us to resolve the increases in bulk solution capacitance (caused by bacteria) from the surface capacitance and bulk resistances that are affected in other ways and previously caused such impedance data to be poorly understood.