Public Abstract
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Two Impedance biosensors based on interdigitated electrode (IDE) arrays were designed, fabricated and tested for detection of low concentration *Escherichia coli* O157:H7.

The first biosensor consists of two set of gold IDE arrays embedded in a SU8-PDMS microchannel. Positive dielectrophoresis (p-DEP) is used to focus and concentrate the *E.coli* cells into the centre of the microchannel, using the first IDE array. The concentrated cells are then guided towards the sensing region microchannel, which has one-third the width of the initial microchannel. The bulk fluid keeps flowing toward the outer channel towards the waste outlets. The second IDE array located in the sensing region is used for impedimetric detection of the *E.coli* cells. A combination of standard photolithography, wet etching and plasma treatment techniques were used to fabricate the biosensor. The *E.coli* cells in the test solution were focused into the centre of the channel when excitation signal of 5 Vp-p at 5.6 MHz was applied across the electrode arrays. Before injecting the *E.coli* cells, polyclonal anti-*E.coli* antibodies were non-specifically immobilized on the sensing electrode array. This ensures specific detection of *E.coli* O157:H7 bacterial cells. As the concentrated *E.coli* cells (antigen) reach the sensing electrode array, they bind to the immobilized antibody sites. This antigen-antibody binding causes a change in the impedance which is measured using an impedance analyzer. The device performance was tested by measuring the impedance, between 100 Hz -1 MHz frequency, before and after applying p-DEP on the focusing electrode array, and after applying p-DEP on both the focusing and sensing electrodes. The result shows clearly that the use of p-DEP on the focusing IDE array significantly increased the measurement sensitivity with the lower detection limit being 3×10^2 CFU/mL. In addition, the use of p-DEP on both electrode arrays increased the measurement sensitivity by a factor of 2.9 to 4.5 times depending on the concentration.

The second biosensor consists of a redesigned focusing region and multielectrode sensing region to improve the efficiency and to be able to detect even lower concentration *E.coli* O157:H7. Similar to the previous design this biosensor also consists of two functional region: focusing and sensing region. In this design, the focusing region consists a ramp down vertical electrode pair made of electroplated gold along with tilted (45 degree) thin film finger pairs, embedded in a microchannel. This configuration improves the concentration and focusing of the bacteria into the center of the microchannel, and direct them towards the sensing region. The sensing region consists of three IDE arrays, with varying number of electrode fingers (30, 20 and 10 pairs respectively), all embedded inside a narrow microchannel and functionalized using anti-*E.coli* antibody. As *E.coli* binds to the antibody, it results in impedance change. The biosensor was fabricated on a glass substrate using SU8 negative photoresist to form the microchannel, gold electroplating to form the vertical focusing electrode pair, thin gold film to form the detection electrode, the finger electrodes, traces and bonding pads, and PDMS to seal the device. This biosensor was able to detect concentrations as low as 39 CFU/mL, which indicates a 7.5 times higher sensitivity, over the previous design.