Flow-based dielectrophoretic biosensor for detection of bacteriophage MS2 as a foodborne virus surrogate

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A flow-based dielectrophoretic biosensor was designed as a proof-of-concept for the detection of foodborne pathogenic viruses and tested using bacteriophage MS2 as a norovirus surrogate. The flow-based MS2 sensor has two main components: a concentrator and a detector. The concentrator is an interdigitated electrode array designed to impart DEP effects to manipulate viral particles toward the detector in a fluidic channel. The detector is made of a silver electrode coated with polyethylenimine (PEI), single-walled carbon nanotubes (SWCNTs), anti-MS2 IgG, and bovine serum albumin for allowing the antibody-antigen biorecognition events. It is positioned at the end of the fluidic channel and is supplied with electrical current for the purpose of measurement. The fluidic channel and the electrode-supporting layer are made of polydimethylsiloxane (PDMS). Serially diluted MS2 suspensions were continuously injected into the fluidic channel at a 0.1mL/min. A cyclic voltammogram indicated current measurements regarding PEI-SWCNTs coated electrodes increased when in comparison with PEI film surface electrodes. In addition, a drop in the current measurements after antibody immobilization and MS2 capture was observed with the developed electrodes. Antibody immobilization on the biorecognition site provided greater current changes with the antibody-MS2 complexes vs. the assays without antibodies. The electric field applied to the fluidic channel at 10 Vpp and 1 MHz, contributed to an increase of current changes in response to MS2 bound on the detector. The change in current signals presented dependence on the concentrations of MS2 in the sample solution. The proposed biosensor was able to detect MS2 as sensitive as 10^2 PFU/mL with a total assay time of 15 min.