Separation and detection of escherichia coli and saccharomyces cerevisiae using a microfluidic device integrated with an optical fibre

ABSTRACT

This paper describes the development of an integrated system using a dry film resistant (DFR) microfluidic channel consisting of pulsed field dielectrophoretic field-flow-fractionation (DEP-FFF) separation and optical detection. The prototype chip employs the pulse DEP-FFF concept to separate the cells (Escherichia coli and Saccharomyces cerevisiae) from a continuous flow, and the rate of release of the cells was measured. The separation experiments were conducted by changing the pulsing time over a pulsing time range of 2-24 s and a flow rate range of 1.2-9.6 μL min −1. The frequency and voltage were set to a constant value of 1 MHz and 14 Vpk-pk, respectively. After cell sorting, the particles pass the optical fibre, and the incident light is scattered (or absorbed), thus, reducing the intensity of the transmitted light. The change in light level is measured by a spectrophotometer and recorded as an absorbance spectrum. The results revealed that, generally, the flow rate and pulsing time influenced the separation of E. coli and S. cerevisiae. It was found that E. coli had the highest rate of release, followed by S. cerevisiae. In this investigation, the developed integrated chip-in-a lab has enabled two microorganisms of different cell dielectric properties and particle size to be separated and subsequently detected using unique optical properties. Optimum separation between these two microorganisms could be obtained using a longer pulsing time of 12 s and a faster flow rate of 9.6 μL min −1 at a constant frequency, voltage, and a low conductivity.

Keyword: Chip in a lab; Dielectrophoretic; Field flow fractionation; Optical fibre; Integrated