

## Performance evaluation of free-space fibre optic detection in a lab-on-chip for microorganism

### ABSTRACT

This paper describes the development of a lab-on-chip (LOC) device that can perform reliable online detection in continuous-flow systems for microorganisms. The objective of this work was to examine the performance of a fibre optic detection system integrated into a LOC device. The microfluidic system was fabricated using dry film resist (DFR), integrated with multimode fibre pigtailed in the LOC. Subsequently, the performance of the fibre optic detection was evaluated by its absorbance spectra, detection limit, repeatability and reproducibility, and response time. The analysis was carried out using a constant flow rate for three different types of microorganisms which are *Escherichia coli*, *Saccharomyces cerevisiae*, and *Aeromonas hydrophila*. Under the experimental conditions used in this study, the detection limit of  $1.0 \times 10^5$  cells/mL for both *A. hydrophila* and *E. coli*, while a detection limit of  $1.0 \times 10^6$  cells/mL for *S. cerevisiae* cells were measured. The results also revealed that the device showed good repeatability with standard deviations less than 0.2 for *A. hydrophila* and *E. coli*, while standard deviations for *S. cerevisiae* were larger than 1.0. The response times for *A. hydrophila*, *E. coli*, and *S. cerevisiae* were 104 s, 122 s, and 78 s, respectively, although significant errors were recorded for all three species for reproducibility experiment. It was found that the device showed generally good sensitivity, with the highest sensitivity towards *S. cerevisiae*. These findings suggest that an integrated LOC device, with embedded multimode fibre pigtailed, can be a reliable instrument for microorganism detection.