Supplemental Data

for

Tom T. Huang, David G. Taylor, Miroslav Sedlak, Nathan S. Mosier, and Michael R. Ladisch

Novel Method for Rapid Prototyping of Microdevices

Exploring the device performance at high cell dilutions, we observed *E. coli* cells expressing GFP at concentrations of $10^5$, $10^6$, and $10^7$ cells/mL prepared by dilution from an initial $10^{10}$ cells/mL. Operating as described above, with the exception that a more sensitive Hamamatsu R3896 PMT replaced the R1527P, Figures 4(a), (b), and (c) show typical results from three replicates at each concentration. Figures 4(b) ($10^6$ cells/mL) and (c) ($10^7$ cells/mL) show high peak density yielding calculated concentrations (counts/(time x flow rate)) of $7.5 \times 10^5$ and $6.5 \times 10^6$ cells/mL respectively, in good agreement with concentrations expected from the dilution factors. At the lowest concentration of $10^5$ cells/mL, Figure 4(a) shows two peaks in 100 seconds, compared with an expected ten cells passing through the view every 400 seconds. To increase the number of fluorescent events, the observation time was increased to 300 seconds. Two successive 300 second observations showed 3 and 6 peaks, yielding a calculated $8 \times 10^4$ cells/mL concentration. Alternatively, a higher flow rate would yield more counts per unit time.

The statistical implications of low count rate at low cell concentration, and conversely high rates at high concentration, led us to examine a range of flow rates. Using the previously described fluorescent antibody labeled *E. coli* O157:H7 cells at $10^7$ cells/mL, we varied the outlet vacuum between 75 and 250 mmHg. Digitized fluorescent signals had peak widths ranging from more than 50 mSec at approximately 75 mmHg, to 1.5 mSec at 250 mmHg, corresponding to a 33:1 flow rate range. The fluorescent signal's peak-to-baseline ratio was more than 2:1 in all cases, and the peak shapes were uniformly Gaussian-like and reproducible.
over the range. Similar results were obtained over the same vacuum range with 1 μm fluorescent polystyrene latex beads (Polysciences, Inc., Warrington, PA, catalog #17154). The beads exhibit much higher fluorescence, with signal ratio of 12:1. Device operability for 20-30 minutes over a range of easy adjusted flow rates was maintained with no observed change in the microfluidic boundary layer.

This work describes the use of microfibers both as a construction material for the creation of microchannels and also a way of directing fluid flow into a narrow band. The use of surface wettability of the hydrophilic microfiber and hydrophobicity for surrounding surfaces, to direct fluid flow into a narrow band inside a micro-channel will enable many applications.