EFFECT OF FLUID FOW RATE ON PARTICLE FILTRATION AND TRAPPING THROUGH MICROFLUIDICS BASED PILLAR MICROFLITERS

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The field of microfluidics has become an attractive and promising research area for wide range of applications. Concepts of point of care diagnostics, lab-on-chip, micro-total-analytical-systems (μ-TAS) in microfluidics for efficient drug delivery, diagnostics, body-fluid analysis, digital logic generation, droplet generation, mixing, cell sorting, separation, counting of cells and much more; Inherent laminar nature of fluid flow through microchannel makes possibilities for separation of fluid particulate components. Separation of particles or biological cells is an important aspect of medical research in diagnosing diseases and finding remedies. Physical microfilters have been reported as a method of obtaining label free and high filtration efficiency for particle separation [1,2]. Microfluidics devices tend to have extensive network of microfilters to enhance the overall throughput of filtration. However, this also causes increased pressure drop through microchannel networks resulting in formation of recirculation and stagnation zones. A flow rate dependent study is provided here. A pillar filter network is simulated at different flow velocities and stagnation zones are visualised.

Passive microfilters based microfluidic channel is designed and simulated using COMSOL multiphysics software (figure 1). Flow dependent stagnation zones are studies using simulation and flow experiments. At low flow rates (~0.1ml/hour) the flow velocity across middle zone of the microchannels was found to be low (thus forming low filtration zone), which is further experimentally verified. A PDMS based microchannel with pillar filter is fabricated using standard microelectronics unit processes. Solution of Polystyrene microbeads of 5μm diameter was used to assess the effect of flow rates on the filtration performance of microfiltration device (figure 2). Set of flow rates i.e., 0. 1ml/hour, 1ml/hour, 5ml/hour and 10ml/hour was used to flow sample through the channel. High resolution optical videos are captured and fluid flow is visualised. Number of stagnant filters reduced with increase in flow rate. This study can be used to optimize physical filters in microfluidics platforms.

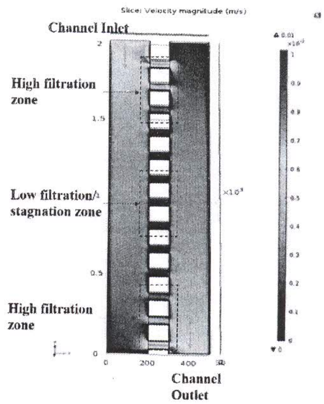

Figure 1: Surface plot of velocity profile of simulated pillar microfilters design

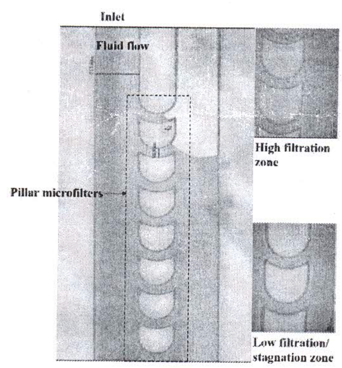

Figure 2: Polystyrene bead (5μm diameter) solution flow at different flow rates through microfluidics pillar filter channel

References

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