Analysing And Optimizing Plasma Separation Designs Using COMSOL: A Computational Modelling Approach

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Abstract

The aim of this research is to explore biofluid behavior in a bifurcated outlet serpentine separator microchannel device and optimize the design to increase plasma separation performance. The researchers used COMSOL Multiphysics to simulate a continuous, passive, high-throughput microdevice for blood plasma separation using an Euler-laminar two-phase modelling technique. The deterministic lateral displacement (DLD) approach and the inertial method were also investigated. Under the inertial model, two potential approaches for enhancement were investigated: considering serpentine channel width and targeting outlet branch channels. The findings revealed that a narrow serpentine channel and a more sharp bifurcation angle resulted in more effective plasma separation. The research gives useful information for the development of microfluidic devices with increased performance and purity in plasma separation applications.
USE OF COMSOL MULTIPHYSICS®:
The model is set up with the Euller the Laminar Flow interface and the Particle Tracing module. For numeric efficiency, a 2D geometry of the channel system is established in order to simulate the deflection of particles due to the inertial force and lateral displacement.
RESULTS:
Figure 1 shows excellent purity from the phid is 0.0005 and the sum of accumulated particles at the plasma outlet is zero, comparing upper and lower cell outlets. Figure 2 shows the dispersed flow velocity and conforms the plasma separation.
CONCLUSION:
The simulation results show that a quick shift in plasma flow direction contributes in the formation of more highly pure plasma. An excellent design for a Bifurcated output serpentine separator is said to linearly broaden the serpentine and widen the bifurcation angle from low to high.
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Figures used in the abstract

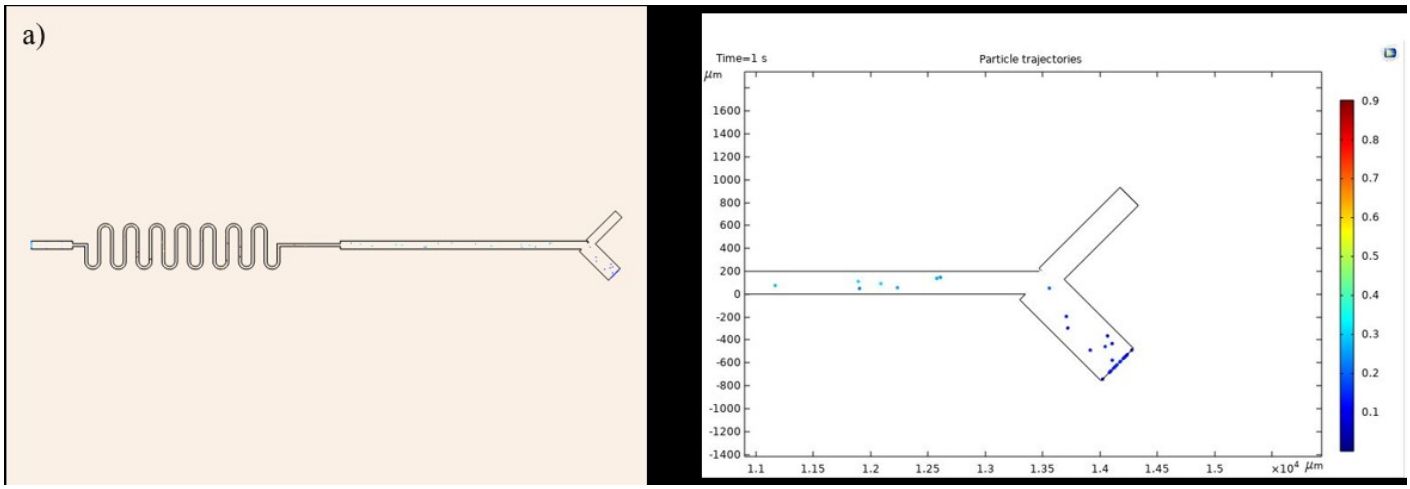

Figure 1 : Figure 1: a) Dispersed flow velocity b) particle trajectory

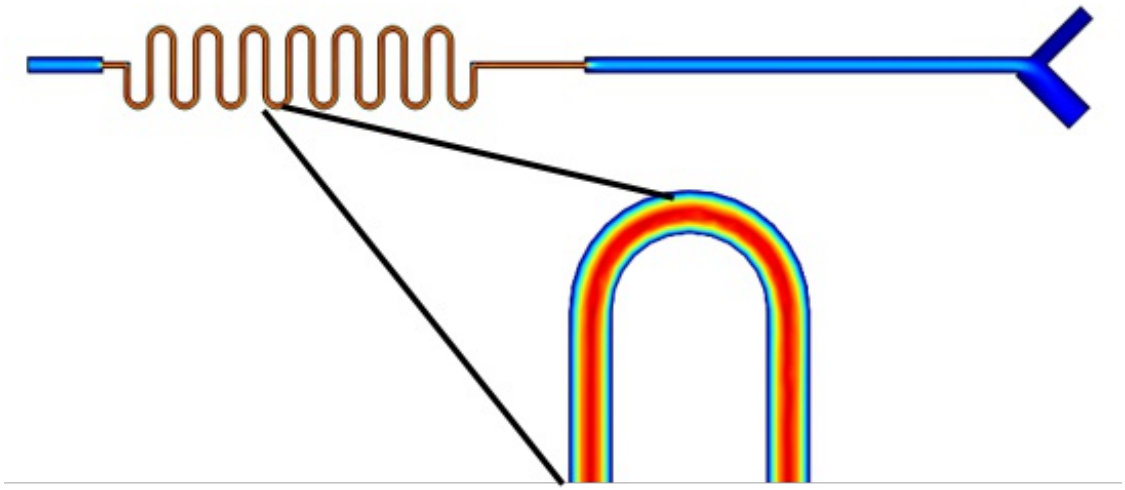

Figure 2 : Figure 2: The serpentine channel: a dispersed velocity flow.