Numerical Modeling of High Aspect Ratio µPillars at Different Viscosities and Flow Rates

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Abstract

The advent of Micro/Nano fluidic technologies has enabled researchers from various fields to use these advancements for analysis and experiments. In this work we present such a device that can be used for analyzing coagulation of blood in a microchannel by measuring the displacement of µPillars. The measure of displacement/bending of these micro structures is used as a tool to see the effects of fluids of different viscosities on pillar movement. The simulation results are compared with experimental results and a reasonable agreement was found between simulation and experimental results.
CFD module of COMSOL Multiphysics® software was used to model our device. In order to incorporate the effects of fluid flowing in a microchannel we used laminar flow sub module which solves continuity and momentum equation and for measuring displacement of µPillars solid mechanics module was used which solves for out of plane strain displacement and also for displacement field u. Multiphysics module was used to couple the above mentioned Physics modules.
Figure 1 shows displacement of an array of µPillars under different flow conditions at different viscosities. Figure 2 and 3 present graphical results for simulations and experiments preformed. Figure 04 presents the experimental setup used. We observed a reasonable agreement between the experimental and simulation results.

Reference

1. Sniadecki, Nathan J; Chen, Christopher S; ,Microfabricated silicone elastomeric post arrays for measuring traction forces of adherent cells, Methods in cell biology,83,,313-328,2007,Elsevier
2. Liang, Xin M; Han, Sangyoon J; Reems, Jo-Anna; Gao, Dayong; Sniadecki, Nathan J; ,Platelet retraction force measurements using flexible post force sensors, Lab on a Chip,10,8,991-998,2010,Royal Society of Chemistry

Figures used in the abstract

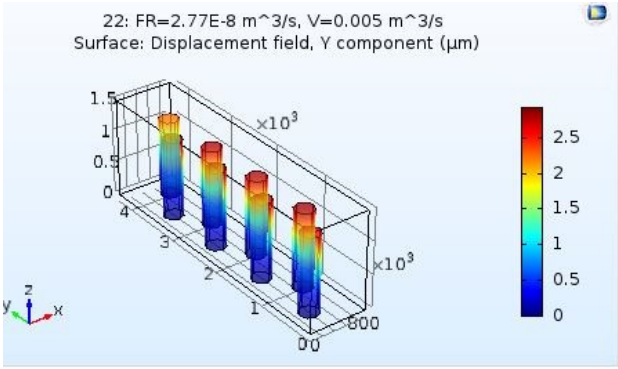

Figure 1

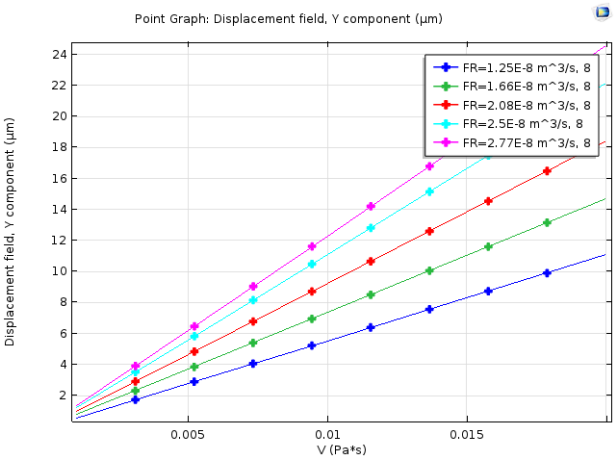

Figure 2

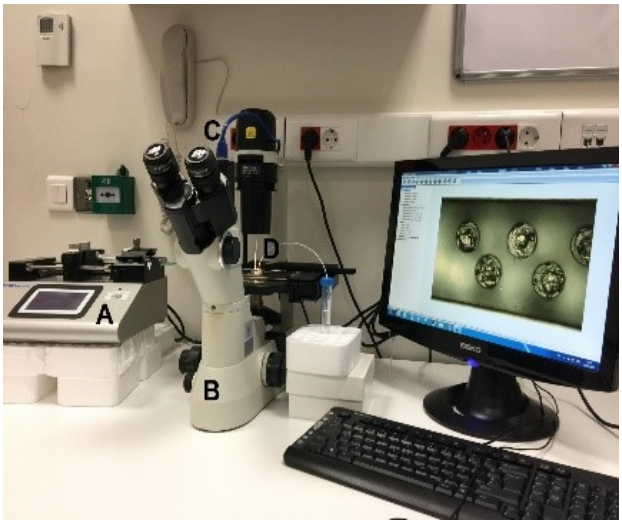

Figure 3

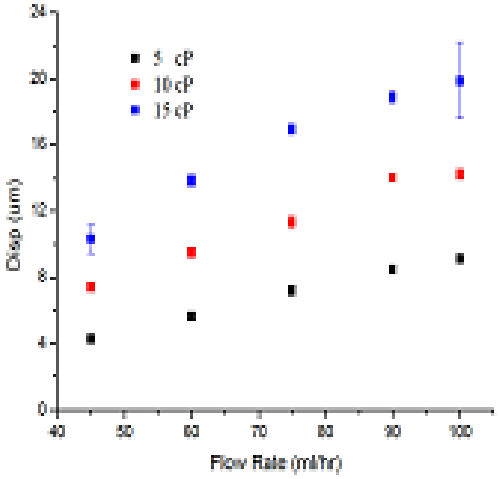
5 cP
10 cP
15 cP
Disp (um)
Flow Rate (ml/hr)
0
4
8
12
16
20
24
40
50
60
70
80
90
100

Figure 4