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Multiscale modeling of blood-plasma separation in bifurcations[1]
XUEJIN LI, Brown University, ALEKSANDER POPEL, Johns Hopkins University, GEORGE KARNIADAKIS, Brown University — Motion of a suspension of red blood cells (RBCs) flowing in a Y-shaped bifurcating microfluidic channel is investigated using a low-dimensional RBC validated 3D model based on dissipative particle dynamics. No-slip wall boundary and adaptive boundary conditions were implemented to model hydrodynamic flow within a specific wall structure of diverging microfluidic channels. Plasma skimming and the all-or-nothing phenomenon of RBCs in a bifurcating microfluidic channel have been investigated in our simulations, including the size of cell-free layer on the daughter channels. The results show that the flowrate ratio of the daughter channels and the feed hematocrit level have considerable influence on blood-plasma separation. Compared with the particle recovery efficiencies of healthy RBCs, malaria-infected RBCs (iRBCs) have a tendency to travel into the low flowrate daughter channels because of the increased stiffness of iRBCs. The simulation results are consistent with previous experimental results and theoretical predictions.

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