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**Probing bilayer–cytoskeletal interactions in erythrocytes using a two-component dissipative particle dynamics model**[1] ZHANGLI PENG, Massachusetts Institute of Technology, XUEJIN LI, Brown University, IGOR PIVKIN, University of Lugano, MING DAO, Massachusetts Institute of Technology, GEORGE KARNIADAKIS, Brown University — We develop a two-component dissipative particle dynamics (DPD) model of the red blood cell (RBC) membrane by modeling the lipid bilayer and the cytoskeleton separately. By applying this model to simulate four different experiments on RBCs, including micropipette aspiration, membrane fluctuations, tank-treading motions in shear flow and bilayer tethering in a flow channel, we validated our model and studied the mechanical properties of the bilayer–cytoskeletal interaction in a systematic and controlled manner, such as its elastic stiffness, viscous friction and strength. In the same time, we also resolved several controversies in RBC mechanics, e.g., the dependence of tank-treading frequency on shear rates and the possibility of bilayer–cytoskeletal slip. Furthermore, to investigate RBC dynamics in the microcirculation, we simulated the passages of RBCs through narrow channels of the flow cytometer in vitro and their passages through the splenic inter-endothelial slits in vivo. The effects of RBC geometry and membrane stiffness on the critical pressure gradient of passage were studied, and the simulation results agree well with experimental measurements.

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