Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

Effective surface tension of red blood cell membranes induced by cytoskeleton meshworks RUI ZHANG, FRANK BROWN, Department of Chemistry and Biochemistry, University of California, Santa Barbara — The membrane of red blood cell (RBC) consists of a lipid bilayer and a two dimensional cytoskeleton meshwork underneath. Its elastic properties are therefore different from a simple lipid bilayer. We introduced a simple entropic spring model to study the meshwork. In this model, adjacent nodes of the meshwork interact with each other through the link of an entropic spring. We run Monte Carlo and Brownian dynamics simulations, and developed some simple analytical theories to understand the simulation results. For a complete meshwork, we found that the cytoskeleton meshwork produced an effective surface tension to the RBC membrane, as far as the height fluctuation of the membrane is considered. This surface tension depends on the wave length of the fluctuation, and shows a crossover at the wave length of the average mesh size. We also studied the case when a fraction of randomly chosen links are disconnected from the nodes, possibly with the help of ATP. In this case, the surface tension changes with the fraction of connected links. Most interestingly, we found a percolation phase transition of the surface tension at long wave length limit. We discussed the experimental results related to our theory. Our model may improve the understanding of certain functions the RBC membrane related to its elastic properties.

Rui Zhang
Department of Chemistry and Biochemistry,
University of California, Santa Barbara

Date submitted: 30 Nov 2006 Electronic form version 1.4