Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Phase Diagram and Breathing Dynamics of Red Blood Cell Motion in Shear Flow[1] PROSENJIT BAGCHI, ALIREZA YAZDANI, Rutgers University — We present phase diagrams of red blood cell dynamics in shear flow using three-dimensional numerical simulations. By considering a wide range of shear rate and interior-to-exterior fluid viscosity ratio, it is shown that the cell dynamics is often more complex than the well-known tank-treading, tumbling and swinging motion, and is characterized by an extreme variation of the cell shape. We identify such complex shape dynamics as 'breathing' dynamics. During the breathing motion, the cell either completely aligns with the flow direction and the membrane folds inward forming two cusps, or, it undergoes large swinging motion while deep, crater-like dimples periodically emerge and disappear. At lower bending rigidity, the breathing motion occurs over a wider range of shear rates, and is often characterized by the emergence of a quad-concave shape. The effect of the breathing dynamics on the tank-treading-to-tumbling transition is illustrated by detailed phase diagrams which appear to be more complex and richer than those of vesicles. In a remarkable departure from classical theory of nondeformable cells, we find that there exists a critical viscosity ratio below which the transition is dependent on shear rate only.

[1]Supported by NSF

Prosenjit Bagchi
Rutgers University

Date submitted: 04 Aug 2011 Electronic form version 1.4