Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

From red cells to soft porous lubrication.[1] QIANHONG WU, ZENGHAO ZHU, Villanova University, RUNGUN NATHAN, Penn State Berks — In this paper, we report a novel experimental study to examine the lubrication theory for highly compressible porous media (Feng & Weinbaum, JFM, 422, 282, 2000), which was applied to the frictionless motion of red cells over the endothelial surface layer (ESL). The experimental setup consists of a running conveyer belt covered with a porous sheet, and an upper planar board, i.e. planing surface. The pore pressure generation was captured when the planing surface glides over the porous sheet. If the lateral leakage was eliminated, we found that the overall pore pressure's contribution to the total lift, f_{air} ≈80%, and the friction coefficient η =0.0981, when U=5 m/s, L=0.381 m, $\lambda = h_2/h_0 = 1$ and $k = h_2/h_1 = 3$, where U is the velocity of the conveyor belt; L is the planing surface length; h_0, h_1 and h_2 are the undeformed, leading and trailing edge porous layer thickness, respectively. f_{air} increases with the increase in U, λ and L, while decreases with the increase in k. η decreases with the increase in f_{air}. If lateral pressure leakage exists, the pore pressure generation is reduced by nearly 90%. All the results agreed well with the theoretical predictions. The study here lays the foundation for applying soft porous media for new type of bearing with significantly reduced friction.

[1]This research was supported by the National Science Foundation (NSF CBET) under Award No.1511096.

Zenghao Zhu
Villanova University

Date submitted: 31 Jul 2017 Electronic form version 1.4