Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Coupling Osmolarity Dynamics within Human Tear Film on an Eye-Shaped Domain LONGFEI LI, R.J. BRAUN, T.A. DRISCOLL, University of Delaware, W.D. HENSHAW, J.W. BANKS, Lawrence Livermore National Laboratory, P.E. KING-SMITH, Ohio State University — The concentration of ions in the tear film (osmolarity) is a key variable in understanding dry eye symptoms and disease. We derived a mathematical model that couples osmolarity (treated as a single solute) and fluid dynamics within the tear film on a 2D eye-shaped domain. The model concerns the physical effects of evaporation, surface tension, viscosity, ocular surface wettability, osmolarity, osmosis and tear fluid supply and drainage. We solved the governing system of coupled nonlinear PDEs using the Overture computational framework developed at LLNL, together with a new hybrid time stepping scheme (using variable step BDF and RKC) that was added to the framework. Results of our numerical simulations show good agreement with existing 1D models (for both tear film and osmolarity dynamics) and provide new insight about the osmolarity distribution over the ocular surface during the interblink.

Longfei Li
University of Delaware

Date submitted: 01 Aug 2013 Electronic form version 1.4