Abstract Submitted
for the DFD07 Meeting of
The American Physical Society

Computational Modeling of Cell Electroporation and Molecular Delivery. HAO LIN, JIANBO LI, Rutgers University — Electroporation is an elegant means to gain access to the cytoplasm, and to deliver molecules into the cell while simultaneously maintaining viability and functionality. In this technique, an applied electric pulse transiently permeabilizes the cell membrane, through which biologically active agents such as DNA, RNA, and amino acids can enter the cell, and to perform tasks such as gene and cancer therapy. Current electroporation technologies fall short of desired efficiency and reliability, in part due to the lack of a good understanding in the pertinent fundamental processes. In this work, we use computational modeling to investigate electroporation-mediated molecular delivery, with a focus on the transport mechanisms long ignored in previous studies. By coupling the Smoluchowski equation governing membrane permeabilization with an electrohydrodynamic model, major aspects including electrophoresis, diffusion, and membrane deformation are investigated. Specifically, the effect of electrical parameters such as field strength, duration, and intra-/extra-cellular electrical conductivity on transport efficacy will be quantified. The eventual objective of this study is to optimize molecular delivery via simultaneously increasing transport and minimizing cell damage due to field exposure.

Hao Lin
Rutgers University

Date submitted: 27 Jul 2007 Electronic form version 1.4