Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Modeling and design of light powered biomimicry micropump utilizing transporter proteins[1] JIN LIU, TSUN-KAY JACKIE SZE, PRASHANTA DUTTA, Washington State University, Pullman WA — The creation of compact micropumps to provide steady flow has been an on-going challenge in the field of microfluidics. We present a mathematical model for a micropump utilizing Bacteriorhodopsin and sugar transporter proteins. This micropump utilizes transporter proteins as method to drive fluid flow by converting light energy into chemical potential. The fluid flow through a microchannel is simulated using the Nernst-Planck, Navier-Stokes, and continuity equations. Numerical results show that the micropump is capable of generating usable pressure. Designing parameters influencing the performance of the micropump are investigated including membrane fraction, lipid proton permeability, illumination, and channel height. The results show that there is a substantial membrane fraction region at which fluid flow is maximized. The use of lipids with low membrane proton permeability allows illumination to be used as a method to turn the pump on and off. This capability allows the micropump to be activated and shut off remotely without bulky support equipment. This modeling work provides new insights on mechanisms potentially useful for fluidic pumping in self-sustained bio-mimic microfluidic pumps.

[1]This work is supported in part by the National Science Fundation grant CBET-1250107

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Date submitted: 01 Aug 2014 Electronic form version 1.4