2010-2011

# Graduate Seminar Series

## The Department of Mechanical Engineering – Engineering Mechanics

Proudly Presents


## Associate Professor Adrienne R. Minerick

**Chemical Engineering - Michigan Technological University**


Adrienne R. Minerick is an Associate Professor of Chemical Engineering at Michigan Tech having moved from Mississippi State University Jan 2010, where she was a tenured Associate Professor. She received her M.S. and Ph.D. from the University of Notre Dame in Chemical and Biomolecular Engineering in 2003 and a B.S. in Chemical Engineering from Michigan Technological University in 1998. Adrienne's research interests include electrokinetics, predominantly dielectrophoretic characterizations of cells, and the development of biomedical microdevices. She earned a 2007 NSF CAREER award and her group has published in the Proceedings of the National Academy of Science, Lab on a Chip, and had an AIChE Journal cover. She is also an active mentor of undergraduate researchers and served as co-PI on an NSF REU site. Research within her Medical micro-Device Engineering Research Laboratory (M.D. – ERL) inspires the development of Desktop Experiment Modules (DEMos) for use in undergraduate chemical engineering classrooms or as outreach activities in area schools. More information is available at www.mderl.org. She lives with her husband, Rob, and two kids in Houghton.

**Thursday, Mar. 24, 2011 4:00 – 5:00 p.m. Room 112, ME-EM Bldg.**

## Erythrocyte Polarizability: Nonlinear Electrokinetics in Medical Microdevices

The controlled manipulation of bioparticles with electric fields has become ubiquitous in biotechnology laboratories, usually in the form of gel or capillary electrophoresis. However, creative use of electric fields for bioparticle manipulation in microdevices has also opened doors to opportunities in medical diagnostics. Such analytical microdevices are also referred to as lab-on-a-chip or micro total analytical systems (μTAS) and offer the potential for rapid, point-of-care diagnostics with implications in geographically remote medical situations. With relatively small electric fields, neutral matter can be manipulated: cells can be accelerated or trapped, proteins can be separated, DNA can be precisely focused, and other separations/purifications can be conducted at low concentrations[1].

This talk will focus on a subset of electrokinetics known as dielectrophoresis (DEP) for the analysis of erythrocytes (red blood cells). Dielectrophoresis is the polarizability of neutral & charged particles in a non-uniform alternating current electric field or a spatially non-uniform direct current field. Recent work in our lab has demonstrated that DEP can be utilized for rapid blood typing, recognition of membrane molecule expression, and hemolysis. Two microdevices have been tested with the ABO-Rh blood groups including a batch AC perpendicular electrode configuration[2] and a continuous sorting DC microchannel with bifurcation and remote electrode configuration[3,4]. Membrane molecule expression has been systematically tested by comparing the DEP signatures of neat erythrocytes and those subjected to a β(1-3)-galactosidase enzymatic reaction to digest the A and B polysaccharides from the membrane surface. The presence or absence of the Rh transmembrane protein is also discernable from the DEP signature[5]. Lastly, hemolysis has also been demonstrated in the low frequency range[6]. By merging the fields of microfluidics, electrokinetics, and biology, handheld microdevices capable of rapidly screening and quantifying diseases, infections, or other ailments may one day become commonplace in medicine.


[1] Minerick, A.R., "The Rapidly Growing Field of Micro and Nanotechnology to Measure Living Cells," Invited Perspective with Cover Figure, *AIChE Journal*, Volume 54, Issue 9, Pages 2230-2237, September 2008.

[2] Srivastava S.K., P.R. Daggolu, S.C. Burgess, and A.R. Minerick, "Dielectrophoretic Characterization of Erythrocytes: Positive ABO Blood Types," *Electrophoresis*, Volume 29, Issue 24, Pages 5033-5046, 2008.

[3] Srivastava, S. K. A. Gencoglu, and Minerick, A. R., "DC insulator dielectrophoretic applications in microdevice technology: a review," *Analytical and Bioanalytical Chemistry*, Volume 399, Issue 1, Page 301, 2010. DOI: 10.1007/s00216-010-4222-6

[4] Srivastava, S. K. and A. R. Minerick, "DC insulator-based dielectrophoretic characterization of erythrocytes: ABO-Rh human blood typing", *Special Dielectrophoresis Issue of Electrophoresis*, under review, submitted January, 2011.

[5] Leonard, K.M. and A.R. Minerick, " Explorations of ABO-Rh antigen expressions on erythrocyte dielectrophoresis: Changes in Cross Over Frequency," *Special Dielectrophoresis Issue of Electrophoresis*, under review, submitted January, 2011.

[6] Leonard, K.M, J.E. Rutan, S.M. Duke, P.M. Jamison and A.R. Minerick, "Dependencies of Human Erythrocyte Lysis in an AC Dielectrophoretic Medical Microdevice," draft available, *Micro-Nanofluidics*, 2011.



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