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AES Newsletter

Inside this issue:

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Our traditionally strong meetings would simply not be possible without help from our supporters. Their donations are greatly appreciated.

Send news for the web page to Webmaster Adrienne Minerick minerick@mtu.edu

Send news for the newsletter to Editor Nancy Kendrick nancy@kendricklabs.com

Contact Matt Hoelter AES Executive Director with questions about the society matt-aes@tds.net

Salt Lake City, Utah: site of the annual meeting of the American Electrophoresis Society on November 7-10, 2010. Don't miss it!

Update from our Meeting Organizers:

The annual AES meeting will be held as Topical Session 3 of the AIChE meeting in Salt Lake City. Two Sunday workshops are detailed on the back of the enclosed Program Grid. The AES sessions will take place for the first 3 days of the meeting, November 8-10, in Salon III in the Hilton. The full schedule for the AES sessions is located at http://aiche.confex.com/aiche/2010/webprogram/T3.html. Of particular interest is the plenary session from 3:15 pm - 5:45 pm on Monday, November 8. The speakers are Jonathan Posner, Bill Ristenpart, Todd Squires, Chia Chang and Anup Singh. In addition to the 9 sessions of oral presentations, the poster presentation will take place on Tuesday, November 9, from 6 pm - 8 pm in Hall 1 of the Salt Palace Convention Center. The business meeting for the society will take place in Salon III (same room as the talks) at 11 am on Tuesday, immediately following the first session of the day. Please stop by if you are interested in hearing more about becoming involved in the society or the organization of the upcoming annual meetings. The society banquet will take place at Buca Di Beppo (202 West 300 South) at 7:30 pm on Wednesday, November 10. The speaker is Henry Harpending, who will discuss human evolution. More information about the speaker is available on his website, http://harpending.humanevo.utah.edu. Tickets are still available and can be purchased at the registration desk. We look forward to seeing you at the meeting!

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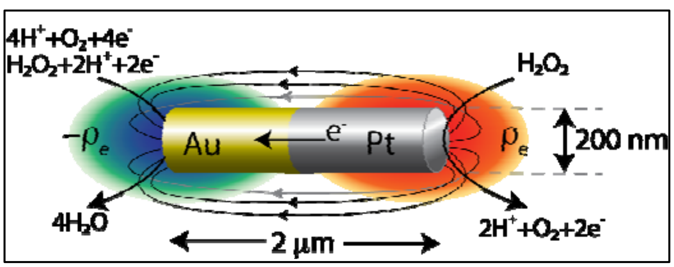
AES 2010 Meeting Co-Chairs

Reaction Driven Electrokinetic Transport and Locomotion

by Dr. Jonathan Posner, Arizona State University,
Plenary Speaker at the 2010 Meeting in Salt Lake City

The majority of electrokinetic systems drive motion of colloidal particles and fluids using externally applied electrical bias. This bias generates an electric field that imparts the electrical body force on the diffuse screening clouds in the electrical double layer at the interface between an electrolyte and a solid or liquid surface. Electric fields can also be generated using heterogeneous reactions that do not require external power sources. These electric fields are generated by a local imbalance in ions and some net charge density due to surface reactions. Self-generated electric fields due to surface fluxes were described more than 50 years ago[1] and can be caused by asymmetry of diffusion coefficients and electrolyte concentration gradient (diffusiophoresis of an electrolyte),[2] or local differential ion surface flux due to transport through an ion selective membrane,[3] catalytic decomposition,[4] or electrochemical reaction.[5] These systems have the potential advantage that the energy used to generate the electrical field for the system is stored in the surrounding fluid and does not require an external power supply.

Reaction and surface flux induced electric fields can be used to drive colloidal electrophoresis. Recently, there has been a series of papers detailing the colloidal transport due to the self-generated fields. This includes using surface reactions to drive electrophoresis of charged spheres in microchip,[6] colloidal patterning,[7] and colloid locomotion of Janus particles.[8]



Electrokinetic locomotion is due to reaction induced charge electrophoresis. Dipolar regions of charge density are generated from asymmetric electrochemical reactions of hydrogen peroxide on a bimetallic Janus nanoparticle. Locomotion results from electrical body forces in the surrounding fluid, which are generated by a coupling of an asymmetric dipolar charge density distribution and the electric field it generates.

Although microorganism locomotion is typically driven by mechanical deformation of solid appendages, Mitchell proposed that an asymmetric ion flux on a bacterium's surface could generate electric fields that drive locomotion via self-electrophoresis.[1,9] Years later, Mitchell's self-electrophoresis mechanism was rejected for cyanobacteria by Pitta & Berg (1995). Recent advances in nanofabrication have enabled the engineering of synthetic analogues to those proposed by Mitchell that swim due to asymmetric ion flux mechanisms. Several realizations of synthetic swimmers, or artificial nanomotors, have been demonstrated with a common theme among these artificial swimmers being the production of species concentration gradients by asymmetric chemical or electrochemical reactions occurring on the surface of Janus particles.[4,10]

Bimetallic Janus particles with hydrogen peroxide fuels are perhaps the most common electrochemical motors. Swimming bimetallic rods were introduced to the community by Paxton et al. (2004)[11] and have been engineered to swim at speeds more than 200 body lengths per second.[12] A nanomotor's velocity can be externally modulated by heat pulses[13] and by electrochemically controlling the local concentration of hydrogen peroxide and dissolved molecular oxygen.[14] Directional control of the nanomotors' motion has been achieved using external magnetic fields by incorporating a ferromagnetic segment, such as nickel, between the platinum and gold segments.[15,16] We and others have shown that nanomotors can pick up, haul, and release micron-scale cargo.[16,17] By hauling cargo of various sizes, we calculated that these nanomotors produce roughly 0.1 pN of force.

Bimetallic Janus particles can convert chemical energy from their surrounding fluid to mechanical energy by reaction induced charge electrophoresis (RICA).[5,18] These particles exhibit asymmetric electrochemical reactions that generate diffuse dipolar ions clouds that result in net charge density and electric fields, as depicted in the figure. The electric fields couple with the net charge density in the double layer driving fluid motion and the particle locomotion. This electrokinetic locomotion is similar to biological locomotion in that they both harvest fuel from their environment to swim. The particle effectively acts as a short-circuited electrochemical cell.

Reaction driven electrokinetic systems and artificial swimmers opens up a new class of autonomous engineered technologies. Opportunities exist in the design, materials, and operation of these devices for applications in autonomous microsystems, drug delivery, and environmental remediation, for example. Understanding the physics of these systems may yield improved design and optimization and translation to new fields. These systems can be described using some classical electrokinetic theories as well as offer new opportunity for theoretical insights for incorporating reactions at interfaces.

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Plenary Talk start 3:15pm
Monday, Hilton, Salon III

Elections are open for 3 AES Councilors: Biosketches and goals of the six candidates are provided below and on the next page. Please cast your vote online at http://www.aesociety.org/about_us/vote.php

Vote for 3 by 10/31/10

COUNCILOR CANDIDATE #1

Rafael V. Davalos, Assistant Professor
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As an Assistant Professor for Virginia Tech - Wake Forest University School of Biomedical Engineering and Sciences, my laboratory investigates electrophoretics for many purposes ranging from early cancer detection to tissue engineering. Strongly committed to developing new methods to detect and treat cancer, I believe microfluidic-based strategies offer a unique means to accomplish this. My work in electrophoretics began at Sandia National Laboratories where I was a Principal Member of Technical Staff in Microsystems and Advanced Concepts Engineering, utilizing insulator-based dielectrophoresis for homeland security applications. As a member of the board, I can help establish collaborations and find applications for electrophoretic-based systems across the spectrum. BS: Cornell University, PhD: University of California, Berkeley.

COUNCILOR CANDIDATE #2

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I have been involved with research related to the mission of AES for the last 7 years, first with microfluidic devices for diagnostics and more recently with electrochemical detection of biomolecules in nanofluidic channels. I have presented previously at the annual meeting and attend regularly.
I am very interested in meeting more members in the society and learning about their research. I would like to do this by helping to organize sessions and acting as a session chair for the annual meetings in 2011 and/or 2012. As AES moves forward, I am curious to see what new separation and detection strategies emerge from research at the nanoscale.

COUNCILOR CANDIDATE #3

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I have had the unusual experience of finding a Society that I should have been a part of for most of my career, but somehow missed it. Adrienne Minerick and Blanca Lapizco- Encinas were invited speakers in one of my sessions at FACSS 2009 (Federation of Analytical Chemistry and Spectroscopy Societies) and stories abounded focused on AES. I have since looked at the program and plan on attending this year's meeting. Further, I believe that I can support my Electrophoresis Community by volunteering my time and energy towards the AES.

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I think you will find me well qualified to contribute. I have been involved in electric field-based separations and manipulations for nearly twenty years, with my first publications focused on field-based control of electroosmosis in capillaries. We are still very active in the area [Anal. Chem. 2007, 79, 4552- 4557; Electrophoresis 2009, 30, 1441-1448; Electrophoresis 2009, 30, 3786-3792 & 3 others (Electrophoresis, LabChip, Anal. Chem.) accepted in 2010] and about half of my publications fit within interest areas of AES.

I have been very active and successful at helping to organize and execute international meetings. Starting with organizing sessions in 2000 for FACSS, I was asked to be Program Chair for 2003, then Governing Board Chair for 2005, and I have served on the Long Range Planning Committee (2004-2010, Chair 2009-10) in addition to being the current Marketing Chair (2009-2012). I would like to contribute to the AES and I believe that I can bring some experience and enthusiasm to do so.

COUNCILOR CANDIDATE #4

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I have been a member of the American Electrophoresis Society since I was a graduate student. I have participated actively in the society as a presenter and a session chair / co-chair. Last year, at the 2009 meeting in Nashville, TN, I was the meeting co-organizer. I would be excited to be part of helping AES continue to grow and advance electrophoresis technology. I think that one way to do this would be to pair established session chairs with newly graduated co-chairs. This would help to retain students as they graduate and encourage them for future leadership in the society.

COUNCILOR CANDIDATE #5

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I am an Assistant Professor in the Department of Chemical Engineering at Carnegie Mellon University. I obtained a PhD in Chemical Engineering from the California Institute of Technology, under the supervision of John Brady. I was next a postdoc with Todd Squires at UC Santa Barbara. A major component of my research concerns modeling micro- and nano-scale electrokinetic phenomena, including electrophoresis and electro-osmosis. It's an exciting time to be in the field. As a councilor, I hope to communicate this to the broader chemical engineering community, particularly by raising the profile of AES sessions and programming at the annual meeting.

COUNCILOR CANDIDATE #6

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PhD, Ecole Polytechnique Federal de Lausanne

I have devoted my research activities to biomolecular and cellular analysis on the microfluidic level and I am convinced that microenvironments can be exploited for fascinating novel analytical techniques, which go way beyond miniaturization of existing electrophoretic technology. For example, specifically tailored microenvironments can provide non-intuitive migration phenomena such as so-called absolute negative mobility but can also be exploited for dielectrophoresis and the analytical applications thereof. As a councilor of the American Electrophoresis Society I will provide my research experience to expand the activities of the society in this exciting area. Furthermore, I will contribute with my long-lived experience of mentoring female students and thus strengthen the activities of the society to foster the equality of women in science.

AES members are invited to submit a paper for a special issue of **ELECTROPHORESIS** focused on **Dielectrophoresis**. The aim is to promote the awareness in the scientific community on the recent developments of this poweful electrokinetic transport mechanism. DIELECTROPHORESIS 2011 will be a highly anticipated special issue and we encourage submission of articles covering all aspects of dielectrophoretic miniaturized systems, including theoretical and practical considerations in their design, fabrication and applications. Additional information and directions for authors are available on the web at: www.wiley-vch.de/home/electrophoresis. The deadline for submission of the manuscripts is set for January 15, 2011.