September 2012
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# AES Newsletter

**Inside this issue:**

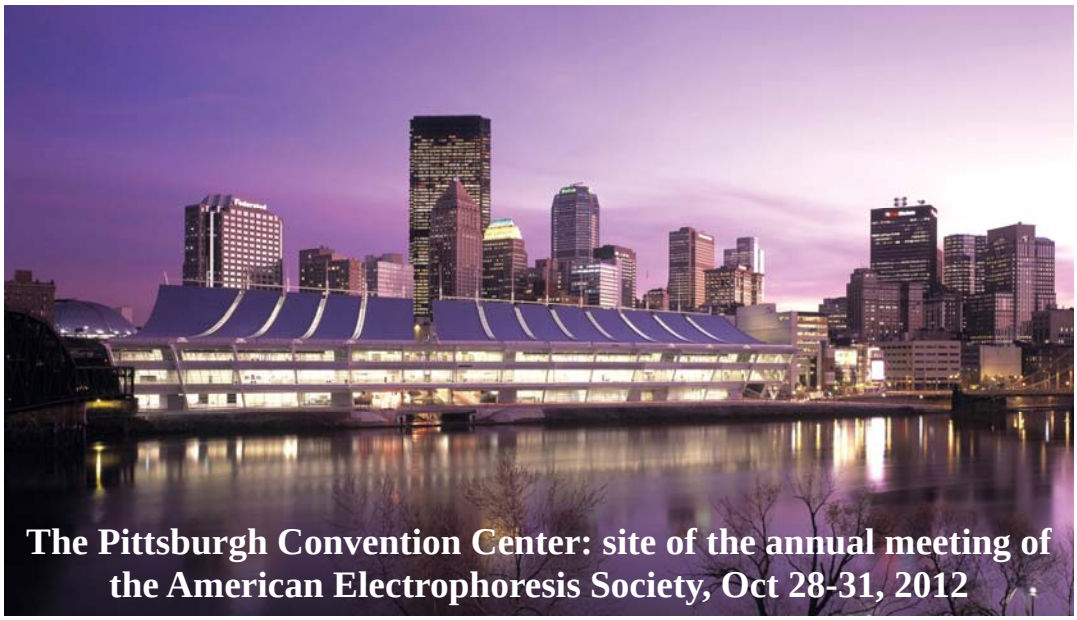




Send news for the web page **www.aesociety.org** to Webmaster Adrienne Minerick **minerick@mtu.edu** or Associate Webmaster Rafael Davalos **davalos@vt.edu**

Send news for the newsletter to Editor Nancy Kendrick **nancy@kendricklabs.com** or Assoc. Editor Victor Ugaz **ugaz@tamu.edu**

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



**The Pittsburgh Convention Center: site of the annual meeting of the American Electrophoresis Society, Oct 28-31, 2012**

**Update from our Meeting Organizers:**

We are pleased to announce the AES 2012 meeting (Oct. 28 - Oct. 31, 2012, Pittsburgh, PA) will have 12 oral sessions and one poster session, with 108 contributions in total. These outstanding technical sessions will include 6 parallel sessions. A preliminary schedule is at the AIChE annual meeting website and on the enclosed program grid. Highlights include:

- **Sunday Oct. 28. Two cutting-edge workshops.** The first is led by Todd Squires (UCSB) on "Microfluidics and Electrokinetics Principles"; the second by Ahsan Munir (COMSOL) on "Modeling of Microfluidics" www.aesociety.org/meetings/2012/workshop_reg.php
- **AES Plenary Session.** Monday Oct. 29th, 3:15 pm to 5:45 pm (more on Page 8).
- **Lunch with Leaders.** Tuesday, Oct. 30th, 11:00 am – 12:30 pm, August Henry's City Saloon, 946 Penn Ave; purchase $5 tickets with registration. For more information, contact Dr. Christa Hestekin (chesteki@uark.edu) or Dr. Alexandra Ros (alexandra.ros@asu.edu).
- **AES Poster Session.** Tuesday Oct. 30th, 6:00 pm to 8:00 pm. Late-**breaking contributions are welcome and will be accepted until October 8th**. Please email abstracts to Victor Ugaz (ugaz@tamu.edu). Awards are given to the best student posters.
- **AES Award Session in honor of Nancy Stellwagen.** Wednesday Oct. 31st, 12:30 pm to 3:00 pm (more on Page 4).
- **AES Business meeting.** Wednesday, Oct. 31st, 6:00 pm to 6:45 pm.
- **AES Banquet.** Wednesday Oct. 31, 7:00 pm, Lidia's, 1400 Smallman St.; tickets are $50 with registration.

We look forward to seeing you at the meeting!

**Aditya S. Khair**
Chemical Engineering Dept
Carnegie Mellon University
akhair@andrew.cmu.edu

**Yolanda Fintschenko**
LabSmith
Director, Business Development
yfintschenko@labsmith.com

# Gradient Elution Moving Boundary Electrophoresis (GEMBE)

By Dr. David Ross
*National Institute of Standards and Technology*

Gradient elution moving boundary electrophoresis is a recently described technique for electrophoretic separations using microfluidic channels or capillaries [1]. The microfluidic device required for GEMBE is simple, consisting of two reservoirs connected by a relatively short, straight microchannel or capillary (see Figure 1). The channel and one of the reservoirs is filled with a run buffer and the other reservoir is filled with a sample to be analyzed. A high voltage is applied to the ends of the channel to drive electrophoretic separation of the analytes. However, with GEMBE there is no injection. A controlled solution counterflow is used to selectively allow analytes to enter the channel, one at a time, where they are detected as step-wise increases in the detector signal. The counterflow is typically controlled through application of a pressure to the head space of the run buffer reservoir. At the beginning of a separation, the applied pressure is high, so that none of the analytes of interest will enter the channel. Over time, the pressure is gradually reduced so that each analyte can enter the channel for detection and quantitation.

GEMBE has a number of advantages over conventional methods of electrophoresis: 1) The simple channel structure is much easier to implement in a multiplexed format. 2) High resolution separations can be performed with relatively short channels, making device fabrication simpler and less expensive. 3) Because there is no injection, there is less variability in quantitative measurements of analyte concentrations. 4) The trade-off between separation time and resolution in GEMBE can be controlled by the rate at which the pressure is varied rather than by the length of the separation channel and the electroosmotic mobility, so method development and optimization is much faster and easier. 5) The counterflow can be used to exclude proteins, particulates or other matrix interferents from entering the separation channel, so that GEMBE can be used to analyze complex samples with very little sample preparation [2,3].

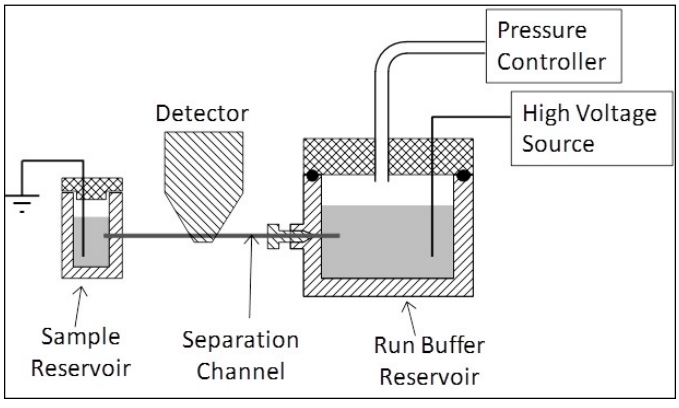



***Figure 1.*** *The basic equipment required for GEMBE consists of a separation channel, reservoirs for buffer and sample, a high voltage source, a pressure controller, and a detector.*

We have found that control of the counterflow in GEMBE is most easily accomplished by controlling the pressure applied to the head space of the run buffer reservoir. We have also tried using a liquid-filled syringe to directly control the volume flow rate through the separation channel, but found that method to be irreproducible because of the long time constant associated with device mechanical compliance, and uncontrolled volume changes due to electrolysis at the electrodes. With control of the head space pressure, the response to changes in pressure is almost instantaneous and the flow rate is insensitive to electrolysis.

The procedure for running a GEMBE separation is as follows: 1) With the high voltage off and the pressure set to a relatively high positive value (the rinse pressure), a new sample is introduced into the sample reservoir. 2) The ground electrode is inserted into the sample reservoir. 3) The high voltage is turned on and the pressure is reduced to the starting pressure for the separation. The pressure is typically held at this value for 10 s to 20 s. 4) The pressure is then ramped downward until all of the analytes of interest are detected. 5) The pressure is then increased to the rinse pressure again, and the voltage is turned off.

The pressure ramp rate is the primary parameter to be varied in the trade-off between resolution and separation time. Slower pressure ramp rates result in separations with higher resolution but longer separation times, while faster pressure ramp rates result in faster, lower-resolution separations. Theoretically, the resolution scales as the -¼ power of the pressure ramp rate if the step width is determined predominantly by diffusion or dispersion in the separation channel; and it scales as the -½ power of the pressure ramp rate if the step width is determined by the width of the detector. The dependence of the separation time on pressure ramp rate is more complicated, but in most cases, it scales roughly as the -½ power of the pressure ramp rate [4,5].

References

[1] Shackman, J. G., Munson, M. S., Ross, D., Anal. Chem. 2007, 79, 565-571.

[2] Strychalski, E. A., Henry, A. C., Ross, D., Anal. Chem. 2009, 81, 10201-10207.

[3] Strychalski, E. A., Henry, A. C., Ross, D., Anal. Chem. 2011, 83, 6316-6322.

[4] Ross, D, Electrophoresis 2010, 31, 3650-3657.

[5] Ross, D, Electrophoresis 2010, 31, 3658-3664.

David Ross
National Institute of Standards and Technology
david.ross@nist.gov

## The Trailing Zone **by Victor M. Ugaz**

*A column highlighting broader perspectives and observations about science and the lives of those who pursue it.*

# Image Analysis

I had a completely different topic in my mind for this column until last Tuesday when something unexpectedly changed. The date was September 11, a time when most briefly pause to remember where they were, what they were doing, and how they felt on that morning in 2001. But this year something deeper was stirred that made me think back to that time eleven years ago in a way that I hadn't before. Since my story has an electrophoresis connection, the time seemed right to share it.

In 2001 I was in the midst of a postdoctoral appointment at the University of Michigan where my research involved studying microchip-based gel electrophoresis of DNA. My experiments required me to continually build and assemble new devices for testing, and I had established a good daily routine to accomplish this: finish device assembly in the early morning, run experiments and analyze data in the late morning/early afternoon, and begin initial assembly of the next day's devices in the late afternoon.

So it was that I spent the morning of September 11 in our cleanroom facility, using a wire bonder to make electrical connections in the chips I planned to test later that day. This instrument happened to be located near a window across from my boss Mark Burns' office. Around 9:30 am, I remember his tapping on the window and trying to tell me something. I didn't understand him (I'm horrible at reading lips) so we both gave up and I went back to work. I now know that he was trying to say something like, "Did you hear what happened?"

If you haven't spent time in a cleanroom before, it can be a surreal experience. You are gowned up from head to toe in an environment where your senses can easily become dulled by the long wavelength lighting and continuous background hum of air handling machinery. It can really feel like you are in another place, somewhere far removed from everyday reality. This feeling was never more evident than when I stepped out of the gowning area later that morning and learned exactly what was going on. The world I had left behind when I entered the cleanroom seemed to have vanished.

A television had been set up in the departmental conference room where some gathered to watch the story unfold. I stopped by but didn't stay long. I made a decision that this was not how I wanted to spend the day. Instead, I was determined to carry on. To not let these events disrupt my life. But simply continuing with my routine of planned experiments didn't seem like enough. I needed something more. A more lasting record of my defiant stand. So that afternoon I proceeded to finish up an ongoing project aimed at streamlining the computer codes we used to analyze video recordings in our experiments. I then composed a lengthy email (shown below) to the group detailing these changes. There's nothing particularly remarkable about the message. The most interesting thing is probably the fact that 80 GB of hard disk space was at that time so huge that it was taxing our departmental backup servers. But to me it had a much deeper meaning. The email was not about image analysis at all. I clearly could have done that any time. It was instead fulfilling a more important need for me, to document that on that day, at that time, in the face of those events, I chose to carry on in my own way.

Although I vividly remember writing this email, I've never gone back to look at it since that day. But this year, for some unexplained reason, I felt compelled to dig it up. Would I react the same way today? Probably not. I think I would instead allow myself to take in the emotions of the moment and not be afraid to meet them head on. Some doors close but others open, endings lead to new beginnings. I know this now but was not so sure about it then.

**From:** "Victor M. Ugaz"
**Subject:** Image Analysis Upgrade
**Date:** September 11, 2001 3:41:39 PM EDT
**To:** Burns Group

This e-mail is for group members doing video image analysis as part of their research.

Since more of us need to do image analysis on a routine basis, we are in the process of upgrading our capabilities in this area. Last week, Dylan upgraded the "Video Drive" on Vulcan to an 80 GB capacity hard drive. This will significantly relieve our drive space problems for now, but we need to continue to be careful about how many files we store. Some general tips are...

1. Capturing videos at half size (320x240) rather than full size (640x480) will significantly reduce the video and tiff file sizes and should be sufficient for most of our needs.

2. It is only necessary to keep either the raw video file or tiff sequence. Keeping both is redundant. If you keep notes about your capture settings, you can always go back to the original video tape later and reconstruct your analysis if necessary.

3. It's a good idea to continually go back and look at your files to see whether you really need to keep video files. A run that was good a few months ago may not be so good now.

The sheer number and size of files on the video drive has placed an excessive burden on the Department's routine backup capabilities. Consequently, Dylan has removed the Video Drive from the backup schedule, and is ordering DVD-RAM disks for us to use to make our own backups.

Once those arrive, each user will be responsible for backing up his or her own files…

[The email continues with detailed instructions for the use of specific macro codes we developed for our analysis]

Lastly, Dylan and I are in the process of getting a duplicate video capture setup in place for the other PowerMac G4. This will be a big help in alleviating the bottlenecks we are now facing with video image analysis. I'll let you know as soon as we get that set up.

That's it for now. Happy image analysis!

Victor

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Victor M. Ugaz, Ph.D.
Postdoctoral Research Fellow
Department of Chemical Engineering
University of Michigan
3074 E. H.H. Dow Building
2300 Hayward
Ann Arbor, MI 48109-2136

## Join AES in the celebration of its

## 2nd Annual Award Session

## in Honor of

## Professor Nancy Stellwagen


**Wednesday Oct 31, 12:30 PM**
**Room 406**
**David L. Lawrence Convention Center**

- **Counterion Condensation and DNA Electrophoretic Mobility**
  Nancy C. Stellwagen and Earle Stellwagen
- **Testing Fundamental Theories for Polyelectrolyte Electrophoresis: Comparing Theory and Experiment As Polyelectrolyte Charge Spacing and Solvent Dielectric Constant ARE Independently Varied**
  David A. Hoagland and Alexey Popov
- **The Electrophoretic Migration of Partially Denatured dsDNA in a Gel: Why Does It Block?**
  Gary W. Slater and David Sean
- **DNA Gel Electrophoresis in the Entropic Trapping Regime: A Versatile Tool for Enhanced Separations and Nanostructural Analysis**
  Victor M. Ugaz and Nan Shi
- **Rational Design of DNA Electrophoresis Devices and the Nanofence Array**
  Kevin D. Dorfman, Daniel W. Olson and Sung-Gyu Park
- **A New Type of Silicon Nanofet Detector with Single-Nanoparticle Sensitivity**
  Denitsa Milanova, Peter Griffin, Matthew B. Kerby, Thomas Niedringhaus, R. Fabian Pease and Annelise E. Barron

**Not an AES member yet? Join now!**

AES costs only $75 for full membership; $25 for students. **Find more information at:** www.aesociety.org/apply/apply_online.php

# Elections are open for VP, Councilor, and Meeting Organizer positions:

Please cast your vote online at: **http://www.aesociety.org/about_us/nominations.php**

**Vice-President:** The Vice-President shall assist the President and/or fill in for the President as necessary. The Vice-President shall oversee annual meeting planning, lead workshop development, organization, and execution, and participate in committees as needed. He or she will also coordinate monthly communications to members. This is a one-year position to complete the term of our current VP. The Executive Vice-President and the Vice President are eligible to run for the position of President, which is also a two-year term. An election will be held amongst the membership if both desire the position of President.

**CANDIDATE #1**

**Mark Hayes**
Associate Professor
Department of Chemistry and Biochemistry
Arizona State University
mhayes@asu.edu
http://chemistry.asu.edu/faculty/m_hayes.asp

I am very interested in helping AES Electrophoresis Society continue to grow and evolve. I envision that we can become a large international society that occupies a core leadership role in fields centered on electric field-based and nano/microfluidic techniques. In examining the various societies in the US, and around the world, there is an empty niche that can be filled by AES as it evolves. There are meetings and conferences, both specialty and multi-topic, that address some aspects of these fields, but there is no professional society. We can mature to fill the role of a professional society that encompasses multiple fields of study (engineering, chemistry, biology, physics, etc.) focused on our core strengths.

I think that I can help AES to continue its growth. I am becoming familiar with existing AES leaders, its history and policies & procedures. I currently serve as a Councilor & as Membership Services Committee Chair. I will be giving the plenary session presentation describing the history of AES Electrophoresis Society to SciX/FACSS this fall. I have organized sessions at last two AES Annual meetings and I have led or helped with programming focused on electric field techniques at SciX/FACSS for the last four years. Through this programming, I became involved in AES and helped to foment our Full Membership in FACSS. In terms of volunteer work for international organizations of scientists, I have been Governing Board Chair, Long Range Planning Chair, Program Chair & Marketing Chair at FACSS. I have organized numerous other sessions and section chairs a variety of meetings. During my time with FACSS, we have completely, from top to bottom changed the way the organization works and its demeanor.

I see electrophoresis and related microscale techniques as the key to fully exploiting new highly efficient miniaturized technologies and I think AES is a great vehicle to further these techniques and relationships between researchers.

**CANDIDATE #2**

**Christa Hestekin**
Assistant Professor
Ralph E. Martin Department of Chemical Engineering
University of Arkansas
chesteki@uark.edu
http://comp.uark.edu/~chesteki/

I am an Assistant Professor in the Ralph E. Martin Department of Chemical Engineering at the University of Arkansas. My research focuses on the development of microchannel electrophoresis for the analysis of physiological concentrations of transient protein aggregates. I have been an active member of the AES Electrophoresis Society since I was a graduate student. My service to the organization has included positions ranging from session chair to meeting co-organizer (2009). I currently serve as a counselor on the AES Electrophoresis board and co-led the introduction of “Lunch with Leaders” at the annual meeting. I would be excited to continue being part of helping AES continue to grow and advance electrophoresis technology.

**Executive Vice-President:** This is a new two-year position in addition to the AES Vice-President. The responsibilities of the Executive Vice-President are to oversee sponsorship, help maintain corporate relationships, and manage the image of the Society for all external identities. The Executive Vice-President and the Vice President are eligible to run for the position of President, which is also a two-year term. An election will be held amongst the membership if both desire the position of President.

**CANDIDATE #1**

**Shashi Murthy**
Associate Professor
Department of Chemical Engineering
Northeastern University
smurthy@coe.neu.edu
http://microfluidicslab.org/murthy/index.html

I am pleased to submit this statement as part of my nomination for the position of Executive Vice President of the AES Electrophoresis Society. My prior activities with AES have included being an organizer of the 2008 Annual Meeting and service as a Councilor. I also have an active role in fundraising from corporate and other private sources for research as well as conferences in the area of biological separations and microfluidics. I believe that this experience positions me well to serve in the role of Executive Vice President.

**Councilors:** This is a three-year position; two Councilor positions will be open this year. The responsibilities of the position are to participate in all teleconferences (once per month), serve on one committee (sponsorship, membership, or ad-hoc), and contribute as needed based on individual contacts or ideas. We also encourage (but don't require) our Councilors to participate as meeting co-organizers.

**CANDIDATE #1**

**Emanuel Carrilho**
Universidade de São Paulo
Instituto de Química de São Carlos
Grupo Bioanalítica, Microfabricação e Separações
Brazil
emanuel@iqsc.usp.br

I am currently associate professor of analytical and bioanalytical chemistry, with special interest in capillary and microchip electrophoresis applications to bioanalysis, and focus on instrumentation. I here request candidature to act as a councilor for this honored society. I believe I can contribute to the Society´s mission by adding an international experience of almost 20 years of work in electrophoretic separations, in all platforms. Being an international fellow, I would like to engage more students into participating in the Society, and to motivate colleagues in Brazil to join and be organized in a community.

**CANDIDATE #2**

**Aditya Khair**
Assistant Professor
Department of Chemical Engineering
Carnegie Mellon University
akhair@andrew.cmu.edu

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 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. This year I've had the pleasure to do just that as co-organizer of the annual meeting.

## Councilor position continued

**CANDIDATE #3**

**Rodrigo Martinez-Duarte**
Postdoctoral Researcher
Laboratory of Microsystems
Ecole Polytechnique Federale de Lausanne
Switzerland
drmartnz@gmail.com

My involvement with AES dates back to 2009 when first presented my research on microfabrication, electrokinetics and microfluidics; particularly on the use of 3D carbon electrodes for DEP. Since then I've had the pleasure to serve twice as session chair and once as poster judge during our Annual Meetings. I believe to have the ambition, energy and team spirit to help moving our society forward while keep embracing its highly interdisciplinary nature… let us envision a 2015 AES that is 1) a widely-recognized society triggering research collaboration between its many academic and industrial members; 2) the point of reference for electrokinetics-related knowledge; and 3) a prestigious platform for boosting talent through research and academic award.

**2014 AES Annual Meeting Co-organizers**: This is a one-year position held jointly by two individuals. These individuals are responsible, with the assistance of the council, for arranging session chairs who field calls for papers, organizing contributions into sessions, and developing an outstanding three-day schedule. These individuals are the key contacts coordinating with AIChE with all co-programming duties and overseeing the entire annual meeting experience.

**CANDIDATE #1**

**Rodrigo Martinez-Duarte**
Postdoctoral Researcher
Laboratory of Microsystems
Ecole Polytechnique Federale de Lausanne, Switzerland
drmartnz@gmail.com

See above

My experience organizing meetings started in 2005 when I led my fellow students in the organization from scratch of a BioMEMS conference, the event counted 650 participants and $20,000+ in sponsorships. Since then, I've also co-chaired an Indo-US workshop and helped publicize conferences. I started going to the AES meeting back in 2009 and since then I've grown fond of it; acting as session chair and poster judge in 2011. Now, I'm looking forward to also chair a session in Pittsburgh! In contrast to other major meetings, AIChE for example, our annual reunion is intimate and "straight to the point"… as a student, I enjoyed how open the meeting is, as a postdoc I have had the opportunity to become more involved, and as a future faculty member I would love my group to become part of it. My vision for the meeting is to preserve its focused sessions but expand it to include more international groups and companies; provide more financial support for student assistance; further increase the impact of the conference proceedings; and conduct more events to tighten our community… little fun at work is always welcome!

**CANDIDATE #2**

**Cullen R. Buie**
Assistant Professor, Mechanical Engineering
Massachusetts Institute of Technology
crb@mit.edu

I'm an Assistant Professor in the Department of Mechanical Engineering at MIT. I received my Ph.D. in Mechanical Engineering from Stanford University, supervised by Juan Santiago. Prior to joining MIT I was a postdoc with Liwei Lin at UC-Berkeley. I've been working in the field of electrokinetics since 2003, from electroosmotic pumps to electrophoretic deposition and dielectrophoresis. I attended my first AES Meeting in 2011 and was impressed by the scientific quality and overall collegiality of the organization. I believe I would bring a fresh perspective and high level of energy to the AES, and I wish to contribute in any way I can to a successful meeting in 2014.

**2013 AES-SciX Meeting Co-organizer:** This one-year position has similar duties as the annual meeting, but co-programs with a SciX representative performing all of the duties discussed above.

**CANDIDATE #1**

**Alexandra Ros**
Assistant Professor
Department of Chemistry and Biochemistry
Arizona State University
Alexandra.Ros@asu.edu
http://roslab.chemistry.asu.edu/

In response to the recent AES announcement, I would like to nominate myself for the position of the 2013 AES-SciX Meeting Co-Organizer. I am Assistant Professor at the Chemistry and Biochemistry Department at Arizona State University and my research interest is focused on bioanalytical microfluidics. I am AES board member since two years. My candidacy is motivated by the various interactions I have had with SciX, formerly FACSS, and my experience with AES. I organized and chaired a session at FACSS/SciX meetings twice, including this year's AES symposium at SciX. I have thus considerable experience in the organization of SciX sessions and the involvement of AES at the SciX meeting. Future involvement of AES in SciX could greatly improve the visibility and service of our society, especially in the field of analytical (bio)chemistry. I thus believe that programs focusing on applications of electrophoresis and related techniques tailored towards the analytical and bioanalytical field would be suited for future AES sessions at SciX.

# Don't Miss the AES Plenary Session at the 2012 Annual Meeting!!

**Monday Oct 29, 3:15 PM, Room 406, David L. Lawrence Convention Center**

| | | |
|---|---|---|
| **Nonlinear Electrokinetics in Porous Media**<br>**(3:15 PM)** |  | **Martin Z. Bazant**<br>**Dept. of Chemical Engineering**<br>**Dept. of Mathematics**<br>**MIT** |
| **The DC Force Exerted On a Charged Microparticle by an AC Electric Field**<br>**(3:45 PM)** |  | **Dennis C. Prieve**<br>**Dept. of Chemical Engineering**<br>**Carnegie Mellon University** |
| **Microfluidic Force Fields for Biochemical and Cellular Analysis**<br>**(4:15 PM)** |  | **Zachary R. Gagnon**<br>**Dept. of Chemical & Biomolecular Engineering**<br>**Johns Hopkins University** |
| **Electrokinetics and High Pressure Liquid Chromatgraphy**<br>**(4:45 PM)** |  | **Don Arnold**<br>**Founder and**<br>**VP, Advanced Technologies**<br>**Eksigent Technologies, Inc.** |
| **Controlling Ionic & Water Transport Through Nanopores: Ionic Diodes, Ionic Transistors and Water Valves**<br>**(5:15 PM)** |  | **Zuzanna Siwy**<br>**Dept. of Physics and Astronomy**<br>**University of California, Irvine** |