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AES Newsletter

Minneapolis Convention Center: site of the annual meeting of the American Electrophoresis Society Oct 16-20, 2011.

Update from our Meeting Organizers:

The annual AES meeting will be held as Topical 3 of the AIChE meeting at the Minneapolis Convention Center (MCC). The AES sessions will take place from Monday Oct 17 to Wednesday Oct 19, mostly in rooms L100D and L100E on the lower level of MCC. See the program grid for session room numbers. Items of interest for the meeting are:

- **Two Sunday workshops** are detailed on the back of the enclosed Program Grid.
- The **Plenary Session** on Monday, Oct 17, room 101D, will feature speakers Eric Cummings, Juan Santiago, Leslie Yeo, Edgar Arriaga, and Michael Bowser. **Parallel sessions** will be held all day on Tuesday, Oct 18.
- The **business meeting** for the society will take place in L100D at 11 am on Tuesday, Oct 18, 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 in the organization of the upcoming annual meetings.
- The **Poster Session** is scheduled for Tuesday, Oct 18, 6-8 pm, at Exhibit Hall B.
- The first **AES Award Session**, in honor of Professor Kelvin Lee will be held on Wednesday, Oct 19, in room 101E.
- The **society banquet** will take place at Hell's Kitchen (80 South 9th St.) at 7:30 pm on Wednesday, Oct 19. A special banquet talk, "3M's Early History and Today," will be given by Dr. Tom Hanschen. Tickets are still available at the registration desk.

We look forward to seeing you at the meeting!

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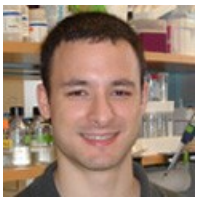

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AES 2011 Meeting Co-Chairs

Inside this issue:

Many thanks to our supporters and friends for their generous contributions.

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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

Isoelectric Focusing of Biological Particles

Gregory G. Wolken and Dr. Edgar A. Arriaga, University of Minnesota, Minneapolis, MN

What electrophoretic separation method can be used to separate different species of bacteria, fractionate subcellular components of a cell homogenate, test the purification of a virus from an environmental sample, and more? Isoelectric focusing (IEF) is a powerful technique for the analysis of biological particles such as cells, organelles, and viruses.[1] This flexible technique can be used for separation and fractionation, functional measurements, and discernment of the chemical properties of biological particles.

Isoelectric focusing is a technique that separates analytes based on their isoelectric point (p*I*), the pH at which they have a net neutral charge. Species migrate through a pH gradient to their p*I*, where they are focused. The p*I* of a small molecule, protein, or particle depends on the chemical composition of its ionizable functional groups (Fig. 1). Therefore, IEF-based techniques are not only useful as separation methods, but can provide valuable information about the chemical features of the species being separated.

The pH gradient in IEF is established by electrolysis of water, supported by anolyte and catholyte and stabilized by carrier ampholytes, or set by amphoteric species immobilized in a gel. The vast majority of IEF experiments are performed using immobilized pH gradients in a gel since this method provides superior reproducibility, linearity of the pH gradient, and many choices of broad to narrow gradients. However, the size of biological particles precludes the use of gels so free-solution IEF methods must be used.

In free-flow IEF, the pH gradient is established by application of an electric field across a separation chamber perpendicular to the flow of a solution through the chamber containing the sample and carrier ampholytes. Species migrate to their p*I* as they travel through the chamber, and can be collected as separate fractions as they exit the device. This technique has been used to achieve separations of organelles from cultured cells in a microfluidic device.[2] The authors demonstrated several applications including the separation of mitochondria and nuclei, and the detection of differences in a functional property of mitochondria, the mitochondrial membrane potential. Free-flow IEF benefits from its speed and the possibility of continuously collecting fractions, which allows for higher-throughput separations.

Capillary IEF is a technique that achieves high-resolution separations with very small amounts of sample and low limits of detection. In this technique, a pH gradient is established by application of an electric field across a capillary containing the sample and carrier ampholytes, and is stabilized by buffer reservoirs containing anolyte (acid) and catholyte (base). Capillary IEF has been used to separate different single-celled organisms such as yeast and bacteria.[3] In this work, the use of fluorescent internal standards allowed the authors to determine the p*I*s of the detected microorganisms. Capillary IEF has also been used to test the purity and measure the concentration of an extraction of virus particles.[4] We recently used this technique to accurately determine the p*I*s of individual mitochondria from cultured cells.[5] The use of internal standards and a mitochondrial-specific fluorescent probe allowed us to measure changes in the mitochondrial p*I* distribution upon mild treatment of the surface of these organelles with a protease.

New developments and refinements in microfluidic free-flow IEF and capillary IEF will lead to more exciting applications of these techniques to the analysis of biological particles. We are confident that these methods will be widely used in clinical and research settings in the future.

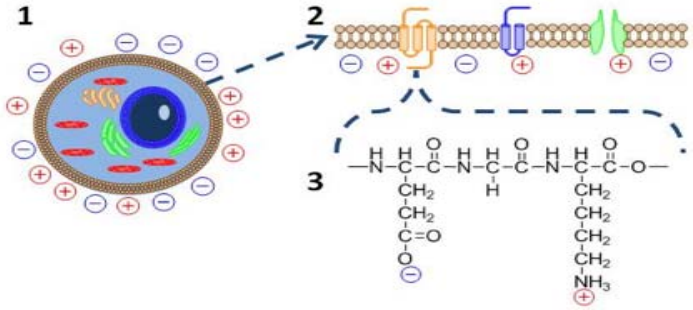

Figure 1. *Origin of pI of a biological particle. Biological particles such as cells (1) have membranes (2) made of phospholipid bilayers that contain membrane proteins, carbohydrates, and other molecules. These membrane components contain ionizable functional groups such as the acidic and basic side chains of amino acids (3) that contribute to the net charge of the particle. Isoelectric focusing methods take advantage of this property to separate biological particles based on their pI.*

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Novel Ionization Source for Microfluidic Mass Spectrometry Interfacing by ***Leslie Yeo*** *&* ***James Friend,*** *Micro/Nanophysics Research Lab, Monash University, Australia;* ***David Go****, Aerospace & Mechanical Engineering &* ***Hsueh-Chia Chang****, Chemical & Biomolecular Engineering, University of Notre Dame*

Coupled with separation techniques such as high performance liquid chromatography (HPLC), mass spectrometry remains among the most widely used tools for chemical and biochemical analysis due to its superior speed, sensitivity, and specificity. With the emergence of efficient sample preparation using microfluidic devices, there is growing interest in interfacing microfluidic devices with mass spectrometers (MS) to allow seamless in-line analysis within an integrated platform [1]. An example of such interfacing is the Agilent Nano LC/MS, which integrates an HPLC chip with MS. As the development of miniaturized MS units progresses, portable uses for forensics and homeland security as well as environmental and therapeutic drug monitoring become a real possibility.

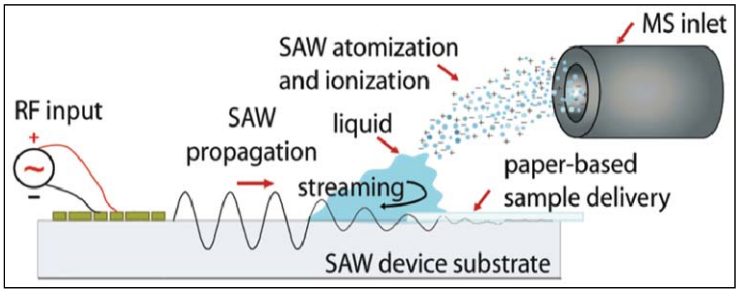
The MS operating principle, wherein gas phase analyte ions are separated based on their mass to charge ratio, necessitates the incorporation of an ionization source. With increasing use of MS for proteomic analysis, soft-ionization methods in which fragmentation of the analyte molecules is minimized are often desirable. The most popular soft ionization methods currently in use are electrospray ionization (ESI) and matrix-assisted laser desorption ionization (MALDI). Nevertheless, these methods are often associated with various setbacks such as spray stability and signal suppression due to matrix ions. There are also practical limitations on their use; for example, ESI is usually limited to polar compounds with large molecular mass. Moreover, the large voltage associated with ESI and the necessity for a laser in MALDI render miniaturization of these ionization sources onto a microfluidic chip interface a challenge.

Recently, a new chip-scale ionization source based on surface acoustic wave (SAW) atomization has been demonstrated as a microfluidic-MS interface (Fig. 1) [2,3]. SAWs are nanometer amplitude Rayleigh waves that propagate along the surface of a piezoelectric substrate at MHz frequencies and above. In the last decade, SAWs have emerged as a powerful tool for microscale and nanoscale fluid actuation and bioparticle manipulation [4,5]. Above a critical power, typically around 1 to 4 W, one to two orders of magnitude smaller than that usually required with ultrasonic atomizers, it is possible with the SAW to sufficiently destabilize the interface of a sessile liquid drop placed atop the substrate such that it subsequently breaks up to form a mist of aerosol droplets around 1 to 10 microns in diameter [6].

Given that the SAW is essentially an electroelastic wave, the atomized droplets possess an inherent charge, typically about 100-300 nC [3]. While this can be smaller than the charge on electrospray droplets, the total charge and current appear to be sufficient to use the SAW atomization process as an ionization source for mass spectrometry [3]. The external pulsed corona source between the SAW device and the MS inlet used in earlier work [2] is not required; the SAW atomization device can exist as a standalone MS ionization source. Further, it was shown that the paper-based wick used to deliver the analyte sample from the reservoir to the SAW device has the capability of filtering sample contaminants, thus allowing low-cost, disposable analysis without the necessity for sample pretreatment or separation [3,7].

The SAW MS ionization platform was demonstrated for the trace detection of both drugs in plasma and in whole blood as well as heavy metals in untreated tap water, without requiring sample preparation or prior separation using chromatographic methods, which is both slow and limits sensitivity due to the similarities between the target analytes and the separation matrix components. In both cases, nM concentrations can be detected with modestly high signal to noise ratios. While not as high, this approaches the detection limits of the gold standard, inductively coupled plasma mass spectrometers (ICP-MS), which is not easily miniaturized and require solid phase extraction prior to detection [3].

Figure 1 Schematic depiction of the SAW-MS interface. The SAW is gener-



ated by applying an input RF signal to the interdigitated electrodes patterned onto the device. The analyte solution, delivered to the SAW substrate through a paper wick, is rapidly atomized when in contact with the SAW propagating on the substrate surface. The atomized droplets comprising the target analyte possess an inherent charge and are directed to the MS inlet for detection.

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Elections are open for VP, 2 Councilors, and Secretary:

Biosketches and goals of the candidates are provided below and on the page insert. Please cast your vote online at:

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VICE PRESIDENTIAL CANDIDATE #1

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Dear AES Members, I would to thank you for this opportunity to participate as a candidate for the Vice President position at AES. I started working on microfluidics during my PhD at University of Cincinnati, where I worked on the development of a micro-chromatograph. Later, I joined the Microfluidics Department at Sandia National Laboratories as a post-doctoral researcher, where I worked on insulator-based dielectrophoresis (iDEP) and had the opportunity to work with Eric Cummings, one the inventors of iDEP. From January, 2005 to December, 2009 I was a professor of at Tecnológico de Monterrey, where I started a research group on microscale bioseparations. In December, 2009 I joined CINVESTAV-Monterrey, a Government Research Center, where I continued our work in microfluidics and electrokinetics. Since August 2011 I am an Associate Professor at the Chemical Engineering Department of Tennessee Technological University. Our research has been focused on the development of electrokinetic techniques for the manipulation of bioparticles; we do experimental work and mathematical modeling. Our objective is to develop electrokinetic-based microdevices that would answer the need of many different applications.

I joined AES in 2008, and it has been a very positive experience for my students and myself to belong to this dynamic research community. I have been a Councilor since 2009 and this has given me the opportunity to collaborate further with AES: organizing the 2010 Electrokinetics workshop, chairman for 2011 Annual Meeting, session organizer for the satellite FACSS meeting, etc. My goals as Vice President are to continue working on making AES the premier scientific and professional organization on electrophoretic techniques and microfluidics.

SECRETARIAL CANDIDATE #1

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My background is a strong knowledge and use of electrophoretic applications. I received a B.Sc in Biochemistry from Liverpool University (UK) before pursuing postgraduate studies in Plant Biochemistry at Lancaster University (UK) where I investigated pollution induced changes in protein expression and honed my skills on classical 2DE and the new IPG technology. I then moved into industry working for a pharmaceutical company (Evans Medical, Liverpool, UK) where I was involved with the development and characterization of a new recombinant vaccine against hepatitis B (and at the time invented the Beckett Blob a.k.a "The Western Smudge"). I then moved to Pharmacia Biotech as a technical support specialist for the electrophoresis product line and then 12 years ago moved to the US as an applications scientist to support the proteomics portfolio of products at GE Healthcare. Since my move to the States I have been involved with the society in some shape or form: at various times being a member, presenter, co-chair or a combination of these.

I am the current secretary of the society but am looking to be re-elected due to my current term drawing to its end. Whilst in this position I have been involved with the sponsorship and awards committees and have taken an active role in attending the monthly (and annual) meetings, as well as helping to co-ordinate them.

As a result of my strong background in classical electrophoretic techniques, I have promoted the society whenever able and due to my position within GE as an applications scientist I am always looking for new ways to apply electrophoretic methods in the laboratory. I would also like to encourage more collaborative efforts between members (and non-members) on sharing and developing new techniques and methodologies in this field.

Continued on insert

COUNCILOR CANDIDATE #1

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As Director of Marketing, Sales, and New Technologies for LabSmith I am committed to furthering the art of science. Since receiving my PhD in Bioanalytical Chemistry from The University of Kansas, I have worked at Sandia National Laboratories as a scientist and as the department manager of the Microfluidics Department. With my Sandia colleagues we developed insulator-based dielectrophresis for homeland security applications. I moved on to direct a global Food Safety team for Thermo Fisher Scientific, establishing multiple collaborations worldwide. As a member of the board, I can use my experience to connect the AES and its members to valuable research and financial partners worldwide.

COUNCILOR CANDIDATE #2

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My research interests are in the area of nanoscale sensors for biophysical analysis. When working with fluids at the nanoscale, electrokinetic phenomena cannot be ignored. Understanding and exploiting these phenomena is a core part of AES and the opportunity to learn about and share new developments in this area is the main reason I am a member of AES. I participate actively in the society both as a presenter and a session chair. As councilor, I will share my knowledge with the other officers and work towards increasing the society's visibility and membership by promoting the society at related conferences and within the broader bioanalytical community. I look forward to seeing everyone at this year's meeting!

COUNCILOR CANDIDATE #3

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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 #4

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I am an Assistant Research Professor in the Voiland School of Chemical and Bioengineering at Washington State University. I have been an AES member since I was a graduate student. I have participated actively in the society as a presenter and would be a session chair at the upcoming AES meeting. My research involves modeling of bioseparations using dielectrophoresis, microfabrication, and using dielectrophoresis for medical diagnostics especially in early detection of cancer. As a councilor, I hope to contribute in mentoring of female students, minority groups and disabled students. One way to attract more students, is to partner with industry and obtain funding, to provide the students with expenses for attending AES conferences. In addition, I would like to organize sessions in future in such a way that it promotes the growth of AES community

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