

AES NEWSLETTER

Inside this issue:

Philly Meeting Photos	2
Poster winners	2
Insulator-based dielectrophoresis: Review	3-4
2009 meeting update	4



Lost in winter's musing? Don't forget the AES when you finally surface.

Many thanks to the Sponsors of the American Electrophoresis Society for their generous contributions.

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Our traditionally strong meetings, with sessions strengthened by plenary speakers discussing state-of-the-art topics, would simply not be possible without help from sponsors. Their donations are greatly appreciated.

Message from the New AES President

The year 2009 brings a new milestone for AES—the start of the Society's second quarter century of existence. These days we continue to hear a lot of buzz about things like “nanotechnology” and “spanning time and length scales.” But this is all old hat to us in the electrophoresis community because we have been actively exploiting nano-scale phenomena for a long time. Indeed, I can think of few more elegant examples than harnessing the fundamental interactions between molecular-scale analytes and their surroundings under the action of applied electric fields.

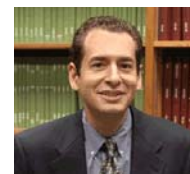
The past quarter century has witnessed an incredible explosion in the development of electrophoretic methods and their evolution into the ubiquitous analytical tools we use every day. It is hard to imagine every time we analyze proteins with 2D gels, sequence DNA using capillary electrophoresis, perform bioanalysis using microchip electrophoresis, or analyze long DNA with pulsed fields, that these methods were not so commonplace in the early years when AES was just getting started.

It is difficult to predict exactly what the future will hold as we move into the next 25 years, but some trends are definitely emerging. For example, a deeper understanding of the nanoscale interactions that govern electrophoretic transport is critically needed as we continue to push the limits of current biomolecule analysis capabilities. The good news is that we now have new experimental tools that allow us to directly probe these interactions, combined with powerful computational methods to capture and predict them. Extraordinary progress is also being made toward understanding the fundamental electrokinetic phenomena in nano-scale channels. This work is revealing new insights that are laying a foundation for entirely new separation methods. Many of these capabilities were unimaginable only a few years ago.

The coming years promise to be an exciting journey, and AES is poised to stand at the forefront of a host of wonderful new discoveries and advances. I am honored to be able to join all of you for this “electrifying” ride!

Victor Ugaz

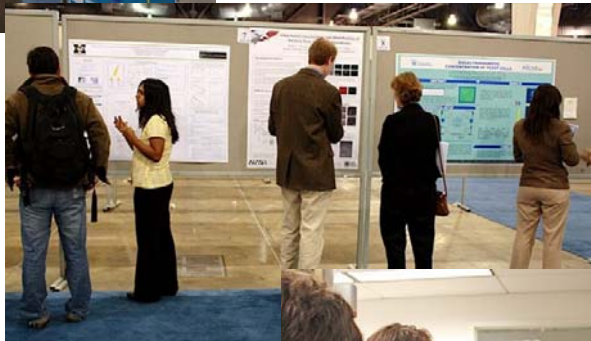
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2008 Meeting Moments:



The Poster presentations (top, right) on Tuesday were intense.



Phil Becket (GE Healthcare, left) and Tom Berkelman (BioRad Labs, right) present travel awards from their companies to students Soumya Srivastava and Jennifer Pascal.



The Field Trip to the University of Pennsylvania Proteomics Center (left, above) was quite interesting!



Stimulating Banquet conversation was found at Maggiano's Little Italy (above two photos).



Banquet Guest Speaker Phillip Westmoreland, Chem Engineering Dept University of Massachusetts (on leave at the National Science Foundation)

Dr. Westmoreland spoke about "Looking ahead at Chemical Engineering: 25 Years, 25 Visions"

Winners of the 2008 Poster Competition (left to right)

Second Place: **Nan Shi**, Chemical Engineering, Texas A&M, College Station, TX

First Place: **Javier Baylon Cardiel** (Professor Blanca H. Lapizco accepting) Tecnologico de Monterrey, Mexico

Third Place: **Alice Jernigan**, Chemical Engineering, University of Arkansas, Fayetteville

Honorable Mention: **Aytug Gencoglu**, Chemical Engineering, Mississippi State University

Judges: Drs. David Garfin, Sharon Sauer and Neil Ivory from the AES Council. All the 2008 poster abstracts will be posted soon on the AES website.

Insulator-based dielectrophoresis for bioparticle manipulation

by Roberto C. Gallo-Villanueva and Blanca H. Lapizco-Encinas, Tecnológico de Monterrey, Mexico

Miniaturization has significantly driven the advancement of separation technology since it offers important advantages: lower cost, reduced sample and reagent consumption, short response time, greater sensitivity and portability. There is a growing interest on the development of separation techniques that can be applied on microdevices [1]. Dielectrophoresis (DEP) is an efficient electrokinetic technique with great potential for miniaturization. DEP is produced by polarization effects when particles are exposed to nonuniform electric fields; the applications of DEP range from biomolecules to parasites [2, 3]. Most research on DEP has been performed employing arrays of microelectrodes and AC electric fields. Electrode-based DEP allows obtaining high electric field gradients employing low applied voltages. However, there are some drawbacks: high cost of electrode construction, complex fabrication processes and decrease of functionality due to fouling effects, which is a common effect when handling biological samples.

There is an alternative manner of carrying out DEP; insulator-based DEP (iDEP) is a technique where the voltage is applied using only two electrodes that straddle an insulating structures array. When an electric field is applied across such an array, the presence of the structures creates regions of higher and lower field strength, i.e., dielectrophoretic traps [4]. Insulator-based DEP systems do not lose their functionality despite fouling effects, which makes them more suitable for biological applications; iDEP systems can be fabricated from a wide variety of materials, including plastics, leading to inexpensive systems, increasing their potential for high throughput applications. Despite the novelty of iDEP, there have been outstanding designs of microdevices successfully employed for bioparticle manipulation. Below is included a brief description of strategically selected research studies that depict some of the foremost examples of successful applications of iDEP. Figure 1 shows a schematic representation of the microsystems employed in these studies.

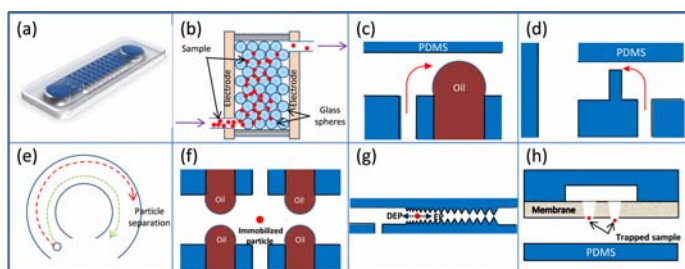


Figure 1. Schematic representation of some microdevices employed in iDEP. (a) Microchannel used by Cummings and Singh [4] (b) Dielectrophoretic filter employed by Suehiro, et al. [7], (c) Oil droplet channel developed by Barbulovic-Nad, et al. [8], (d) Microdevice used by Kang, et al. [9], (e) Circular channel proposed by Zhang, et al. [10], (f) Device with oil menisci insulating posts developed by Thwar, et al. [11], (g) Saw-tooth microchannel employed by Pysher and Hayes [12], and (h) Microchannel with porous membrane developed by Kovarik and Jacobson [13].

In 2003 Cummings and Singh [4] reported the application of an array of insulating posts inside a microchannel for microparticle manipulation (Fig. 1a). This same configuration was employed later for bacterial and protein manipulation [5, 6]. In that same year Suehiro *et al.* [7] developed a dielectrophoretic filter by employing spherical glass beads as insulators between two electrodes for the removal of yeast cells suspended in water using AC fields (Fig. 1b). In 2006, Barbulovic-Nad *et al.* [8] produced a nonuniform field by intercalating an oil droplet inside a microchannel (Fig. 1c), where the size of the oil droplet was manipulated to achieve a dynamic iDEP system that was tested by employing polystyrene particles of different sizes and applying DC fields. In 2006, Kang *et al.* [9] demonstrated dielectrophoretic separation of particles utilizing an insulating block inside a microchannel, where the particles experienced negative DEP in the corners of the block deflecting from its electrokinetic path according to their size (Fig. 1d). In 2006, Zhang *et al.* [10] reported experimental and simulation research on the development of a circular channel with electrodes on its extremes to continuously separate particles according to size (Fig. 1e). A dynamic system where an oil menisci was used to form dynamic dielectrophoretic traps and immobilize particles inside a channel (Fig. 1f) was proposed by Thwar *et al.* in 2007 [11], where the immobilization of polystyrene particles was achieved under DC current. In the same year, Pysher and Hayes [12] separated live and dead bacteria by using a gradient of dielectrophoretic traps in a microchannel with a saw-tooth geometry, where the width of the channel decreased longitudinally to the flow, thus increasing the compression of the electrical field and dielectrophoretic force (Fig. 1g). In 2008, Kovarik and Jacobson [13] used a membrane with trapezoidal pores (Fig. 1h) to achieve multiple dielectrophoretic traps inside a microchannel and collect polystyrene particles and bacteria.

In conclusion, the development of iDEP has advanced significantly in the last few years. The studies reviewed here demonstrate that this powerful and dynamic technique has an enormous potential for bioparticle manipulation. Nevertheless, much work is needed to achieve a complete iDEP microdevice able to handle complex biological samples. It is expected that the development of iDEP will continue to grow considerably in years to come.

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We are pleased to announce that the 2009 AES Meeting will be held on November 8-13 in Nashville, TN as a AIChE Topical Conference. Mark your calendars!

The 2009 AES meeting will be held at the Gaylord Opryland Hotel, a legend among Nashville hotels. Under majestic, climate-controlled glass atriums, you'll be surrounded by nine acres of lush indoor gardens, winding rivers and pathways, and sparkling waterfalls where you can unwind, explore, shop, dine, and be entertained to your heart's content. The 2,881 guest rooms (including 200 suites) at Gaylord Opryland are as grand as the property itself. Inviting décor and tasteful furnishing are designed to create authentic Southern-home comfort (as described on the hotel website).



#	Session Description
1	Advances in Proteomic Analysis & Microfluidic Technologies
2	Nanoscale Electrokinetics II
3	Biomems and Microfluidics: Novel Applications
4	Poster Session:
5	Nanoscale Electrokinetics I
6	Biomems and Microfluidics: Biomedical Diagnostics
7	Biomems and Microfluidics: Sensing, Detection, and Integration
8	Advances in Electrokinetics & Electrophoresis: Particles and Biomolecules
9	Advances in Electrokinetics and Electrophoresis - Fundamentals
10	Advances in Proteomics: New Technologies

The call for papers (PTP, Proposal To Present) for the 2009 AES meeting is now open! The program is sketched out in the table above. We are still looking for a few session chairs so please be sure to contact us if you're interested. In addition, abstracts for any of the above sessions should be emailed to the meeting organizers at the addresses below.

Watch: www.expertreviews.com

for a review of the 2008 AES meeting in Philadelphia, being written by Dave Garfin, AES Past-President in the journal *Expert Review of Proteomics*.



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