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AES Newsletter

Dog Days of Summer? Not for members of the American Electrophoresis Society - we are looking ahead to our annual meeting held jointly with AIChE! Join now and attend. Weimaraner photos courtesy of Adrienne & Rob Minerick, Mississippi State, MS

Inside this issue:

Many thanks to our Sponsors for their generous contributions.

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Our traditionally strong meetings, with sessions chaired by invited plenary speakers discussing state-of-the-art topics, would simply not be possible without funding from sponsors. Their support is greatly appreciated.

We also thank NIH for travel grant support for 2005.

The Annual AES Meeting at the San Francisco Hilton Nov 13 - 17, 2006 is on track and looking strong.

Overview: **Monday, Nov. 13** will feature two plenary speakers as well as two BioMEMS-Microfluidics sessions. **Tuesday** will include three sessions on Advances in Electrophoresis, Electrokinetics, and Proteomics, followed by an evening poster reception. Two sessions on **Wednesday** (CE and Microdevices) will leave afternoon time to explore the city, followed by the AES business meeting and banquet. **Thursday** will feature 3 full sessions on Electrokinetics & Microfluidics, followed by a strong **Friday morning** session on Electrokinetics & Electrophoresis. See http://aiche.confex.com/aiche/2006/techprogram/D1109.HTM for details, including abstracts.

The AES Banquet will be held either at the King George Hotel or the Stanford Court Hotel in downtown San Francisco after the business meeting on Wednesday evening, Nov 15. Although the banquet fee of $55 may seem high, in fact the AES will subsidize the fee $5-$10 per person if necessary to give our members a good value. Don't forget to check the box when registering.

Early bird registration (Deadline Oct 6) for the meeting costs $540 for AES members and $810 for non-members so the $75 membership fee is well worth it. The society needs your support to maintain its growing momentum. Please join online at the AES web site: www.aesociety.org.

Adrienne

Victor Ugaz

Meeting Co-organizers

Better Cellular Manipulations through Electricity: Electroporation

by Adrienne R. Minerick,
Mississippi State University

A cell's membrane is comprised of a phospholipid bilayer serving many functions. These include enclosing the cell interior for the protection of organelles and proteins, and to provide an optimized climate for molecular reactions necessary for cellular functions. The membrane controls this internal environment by regulating the movement of material into or out of the cell via specialized channels. For a variety of genetic engineering and bioMEMS (bio Micro Electro Mechanical Systems) applications, it is advantageous to transiently circumvent this membrane barrier to either add material to a cell or remove material from a cell. Two main strategies accomplish this: chemical treatments and electroporation (aka electropermeabilization or electropulsation). Electroporation is routinely used due to its effectiveness with fewer residual affects on the cell after treatment.

Electroporation involves the use of high voltage pulses into a cell suspension to overcome the capacitive barrier of the membrane [Gehl 2003]. Pores in the membrane open rapidly once the transmembrane potential of the membrane is exceeded by the electric field. However, it takes on the scale of minutes for the pores to repair themselves and return to their normal lipid bilayer configuration [Gehl 2003]. Once the pores are open, movement of material through the open pores can be accomplished passively via diffusion or actively via electrophoretic means. Teissie et. al. describes five kinetic steps of electroporation as a) an induction step where the externally applied pulse locally changes the membrane potential, b) an expansion step where defects in the membrane expand, c) a stabilization step where molecules are arranged to form a transiently stable pore in the membrane, d) a resealing step in which the pore shrinks and the membrane returns to its intact, continuous configuration, and e) a memory effect where some structural properties of the membrane are still weakened at that location for hours after the treatment [Teissie 2005].

Careful control of the electric field enables the treatment to enact only transient and reversible effects on the cell membrane. However, it should be noted that current knowledge is lacking regarding molecular level lipid assemblies, reorganization, and subcellular impacts [Teissie 2005]. One key tuning parameter for the electric field is the use of square waveform pulses [Gehl 2003]. Square waveform generators allow the electric pulse length and amplitude to be independently controlled. Ballpark tuning is accomplished based on cell size; large cells require smaller electric field strengths than small cells [Gehl 2003]. Tuning of the amplitude to greater values causes a large cell surface area to be permeabilized [Gabriel 1997]. Alternatively, tuning to longer pulse durations causes a greater molecular reorganization in the permeabilized area and thus a larger pore [Gabriel 1997].

Observations have shown that pores first form at the end of the cell nearest the positive electrode followed sequentially by pore formation at the end of the cell nearest the negative electrode [Gabriel 1997]. Electrophoretic loading of DNA into the cell can be accomplished simultaneously because DNA moves during the pulse (longer the pulse, the more efficient this loading is) toward positive potential, thus entering the cell through an open pore. Pore resealing is a minutes-long process, which can be sped up in the presence of a surfactant, poloxamer 188, [Lee 1992] or by increasing the temperature just after permeabilization [Gehl 2003]. Since the interior of the cell is exposed for many minutes to the surrounding media, the composition of the external media should be regulated to avoid adverse side affects on the interior cell chemistry [Gehl 2003]. It can also be important, for viability reasons, to allow treated cells to stabilize before moving forward with additional cell handling procedures; recently electroporated cells are vulnerable to further damage due to weakened structural proteins in the membrane [Teissie 2005, Gehl 2003].

Applications of electroporation include the addition of DNA, RNA, proteins, dyes, or drugs into the cell interior. This technology has even been applied to deliver drugs in vivo including the exploration of transdermal drug delivery. [Prausnitz 1999]. Alternative uses include field-induced apoptosis of cancer or tumor cells *in vivo* [Edd 2006]. The following resources are helpful for further reading.

Gehl, J. "Review: Electroporation: theory and methods, perspectives for drug delivery, gene therapy and research." *Acta Physiol Scand* **177**, 437-447, 2003.

Gabriel, B. and J. Teissie, "Direct observation in the millisecond time range of fluorescent molecule asymmetrical interaction with the electropermeabilized cell membrane." *Biophys J.* **73**, 2630-2637, 1997.

Teissie, J., M. Golzio, and M.P. Rols, "Mechanisms of cell membrane electropermeabilization: A minireview of our present (lack of?) knowledge." *Biochim. et. Biophys. Acta*. 1724, 270-280, 2005.

Edd, J.F., L. Horowitz, R.V. Davalos, L.M. Mir, and B. Rubinsky, "In vivo results of a new focal tissue ablation technique: Irreversible electroporation." *IEEE Trans. Biomed. Eng.* **53 (7),** 1409-1415, 2006.

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Mark your calendars…

The AES Satellite Symposium on Advanced Electrophoresis Tools will be held October 2, 2006 in conjunction with the CEPharm International Symposium at the Hyatt Regency, Jersey City, NJ

The American Electrophoresis Society (AES) and California Separation Science Society (CaSSS) are pleased to announce the first in a series of jointly-sponsored satellite symposia with CEPharm on electrophoresis in the pharmaceutical and biotechnology industries. While CEPharm will continue to offer state-of-the-art programming and short-courses in practical capillary electrophoresis, the AES will feature speakers as well as hands-on training in areas that are complimentary to Capillary Electrophoresis. Attendees at CEPharm 2006 will not only hear about the latest work in capillary electrophoresis but will also learn about new developments in the broader field of electrophoresis.

This year, the AES sessions will focus on applied microchip and preparative electrophoresis and cross-platform reproducibility. The opening session will begin with a Plenary lecture on the foundations and future of lab-on-a-chip analysis followed by papers on commercial microchip platforms. The late-morning session will highlight commercial preparative platforms, including contributions from Agilent, Becton-Dickenson, and BioRad. The final session will feature a trio of papers on multidimension proteomics platforms and finish with a panel discussion on platform reproducibility led by several speakers from the AES and CEPharm oral sessions.

Following the panel discussion, Caliper Life Sciences will host a hands-on training session for their LabChip®90 microchip analyzer. Don't miss this chance to get your hands on this state-of-the-art, lab-on-a-chip platform!

Featured Speakers Include:

Lab-on-a-Chip

Prof. J. M. Ramsey, UNC Chapel Hill

Dr. S. Jovanovich, Microchip Biotechnologies

Dr. A. Chow, Caliper Life Sciences

Preparative Electrophoresis

Dr. T. Preckel, Agilent

Dr. P. O'Mullan, Becton-Dickenson

Dr. A. Paulus, Bio-Rad Laboratories

Mult-Dimensional Separations Platforms

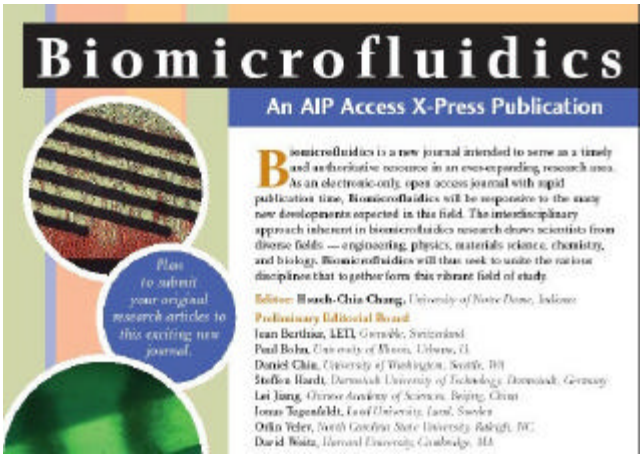
Dr. A. Paulovich, Fred-Hutchinson Cancer Center

Dr. N. Kendrick, Kendrick Labs Inc

Dr. D. Speicher, Wistar Institute

Cornelius Ivory
Washington State University

Andrea Chow
Caliper Life Sciences



Submit an article from work presented at the annual meeting to a special edition of the new journal *Biomicrofluidics*. Contact our meeting organizers (see front page) for a full-page flier and more information. See also: http://bmf.aip.org

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Electrophoresis
Past, Present, and Future

Newsletter subscriptions are complimentary with AES membership. For more information or to join AES contact Matt Hoelter (see above). To submit articles contact Nancy Kendrick.

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Announcement: Three Councilors Needed!

There's been an unusual development this year: Scott Rodkey, our Vice President scheduled to take the Presidential reins in Nov 06, is resigning from the council for personal reasons. In the interests of stability for the society, the AES council has unanimously voted at Scott's suggestion to retain Dave Garfin as President and Nancy Kendrick as Past-President for another term. Dave and Nancy have agreed to rerun. Furthermore, the position of Vice President is traditionally filled from the Council. Dave Garfin is pleased to announce that Victor Ugaz, current Councilor with term expiring in 2007 and also this year's Meeting Co-organizer, has agreed to run for Vice President in Nov. 2006 with full approval of the other members. His term as Councilor will expire at that time.

Three councilors will be elected at the November meeting based on results of October email balloting. The 3-year terms of councilors, Nancy Stellwagen from the University of Iowa, Bob Stevenson from the Abacus Group and Victor Ugaz from Texas A&M University will expire this year.

What the position entails: The 3-year position of AES Councilor doesn't take a lot of time but nevertheless is quite important to the Society. The Council includes the President, Past President, Secretary, Treasurer, six Councilors, and three non-voting members (Executive Director, Webmaster and Newsletter Editor). The council meets formally in person at the annual meeting, and throughout the year by email and telephone conference. Important issues are discussed by the Council as they arise. After full consideration a vote is taken and a course of action implemented. It's also an opportunity to interact with a dynamic and intellectual group. Contact David Garfin, President (degarfin@sonic.net) by email if you wish to nominate a member or run yourself for AES Council. Please attach a biographical sketch to the message suitable for an email ballot. Photos are welcome.

Dr. Scott Rodkey, University of Texas

Dr. Bob Stevenson, Abacus Group

Dr. Nancy Stellwagen, University of Iowa

Many thanks to our Vice President, Scott Rodkey, and Councilors Bob Stevenson and Nancy Stellwagen, whose terms have expired.

As in 2005, a proposal is pending with NIH requesting support for graduate student /postdoc travel and registration expenses. If successful, the timeline on this will once again be in early October.