Summer, 2007
Volume 12, Issue 3

AES Newsletter

Let us have Serenity Now in the summertime. For the AES meeting, Nov. 5-9, 2007, will bring considerable excitement.

Inside this issue:

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

News from our Meeting Organizers

We are pleased to announce that the 2007 annual AES meeting program, consisting of 3 sessions on Monday (Nov. 5), 4 on Tues, 3 on Wed, 3 on Thurs, and 1 session on Fri is locked and loaded. The meeting is being held in conjunction with the American Institute of Chemical Engineers (AIChE) as Topical 3. **To view the entire program** go to: http://aiche.confex.com/aiche/2007/techprogram/D1199.htm. **The early registration deadline for the meeting is Oct 1.** To register, fill out the registration form at the AIChE website http://www.aiche.org/Conferences/AnnualMeeting/index.aspx and submit.

This year's AES meeting offers opportunities to hear from some of the Nation's leading researchers in the field including Dr. Carol Giometti (Argonne National Laboratory), Dr. Katheryn Resing (University of Colorado at Boulder), and Dr. David Friedman (Vanderbilt University). Dr. Giometti, Resing, and Friedman will be sharing some of their exciting research at the AES Plenary session scheduled for Monday, November 5th at 8:30 AM. The AES and and Dr. Bruce Gale are also sponsoring a field trip on Monday at 3:00 PM to the University of Utah Center of Excellence for Biomedical Microfluidics. Tickets can be purchased when you submit your AIChE registration; see item T2 ($15.00). Don't forget to come and enjoy and intellectual evening with other AES friends at the Bioinformatics Dinner scheduled for Wednesday, November 7th; tickets are $50.00 and can be purchased along with your AIChE registration (see item No. 303).

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AES 2007 Meeting Co-Chairs

Monoliths: A new breed of separation media for chromatography

by Frantisek Svec, *Lawrence Berkeley National Lab*

Monoliths are separation media in the format that can be compared to a single large "particle" that does not contain interparticular voids. As a result, all the mobile phase must flow through the stationary phase. This convective flow greatly accelerates the rate of mass transfer. In contrast to diffusion, which is the typical driving force for mass transfer within the pores of particulate stationary phases during chromatographic processes, convective flow through the pores enables a substantial increase in the speed of the separation.

The first thoughts related to what we today call monoliths can be traced down to the works of the Nobel Price winner Richard Synge, who in 1952 envisioned "a continuous block of porous gel structure" [1]. First attempts to make "single-piece" stationary phase from highly swollen polymer gel and open-pore polyurethane foams during the late 1960s and the early 1970s were less successful. Interest in the monolithic formats has only been revived in the late 1980s when novel approaches towards true monoliths such as compressed hydrophilic gels, macroporous polymer discs, columns, tubes, as well as silica rods, have been developed [2].

Recently, a distinct trend to miniaturization and application of monoliths in capillary and microfluidic formats can be observed. Fig.1. shows porous polymer monolith in a microfluidic channel of a chip. The photoinitiated polymerization process via which this monolith was prepared enables patterning of the monolith within the device and also allows for the preparation of fluidic systems with multiple chemistries and/or functions.

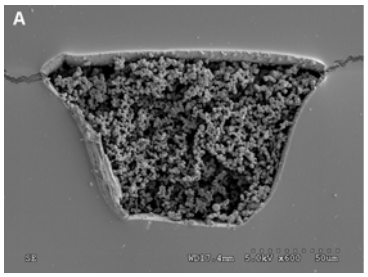

Fig. 1. SEM micrograph of porous polymer monolith in a COC microfluidic chip.

The first microanalytical monolithic devices were capillary columns for electrochromatography. CEC practitioners who had switched from HPLC and CE quickly realized that creating retaining frits in capillaries and packing stable microcolumns with beads were very challenging. This spurred the development of alternative column technologies, including monolithic separation media prepared in situ. As a result of their unique properties and simplicity of preparation, monolithic columns attracted considerable attention, and a plethora of chemistries and approaches soon became available [3]. CEC appears to be extremely useful in applications where high column efficiency can make a big difference, such as the proteomic separation of complex peptide and/or glycan mixtures, followed by MS detection. In addition, electrochromatography is easily amenable to microfluidic chips since it does not require external pumps to achieve flow through the device. Fig. 2 illustrates the power of CEC with the separation of a tryptic digest of cytochrome *c*.

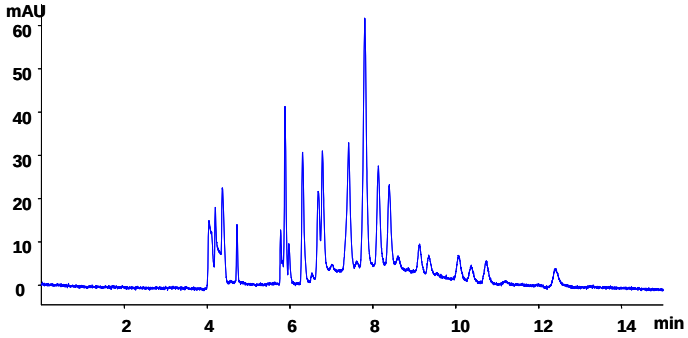

Fig. 2. CEC separation of tryptic digest of cytochrome *c* using a polyacrylate based monolithic capillary column.

NanoHPLC is another domain where monolithic columns are gaining attention. Once again, the simplicity of the in situ preparation easily defeats quite cumbersome packing of narrow bore capillaries with particles. Even more important is the excellent permeability of monolithic columns to flow. While a 20 µm I.D. capillary column packed with sub 2 mm particles may be difficult to run in standard chromatographic equipment due to excessive back pressure, a monolithic column exhibits manageable back pressure even at a column length of 10 cm [4]. Probably the best demonstration of the performance of a monolithic column is the reversed phase separation of tryptic digest of a microorganism *Shewanella oneidensis* in a 70 cm long, 20 µm I.D. silica based monolith. The separation in a 750 min long gradient enabled the identification of 2367 different peptides covering 855 distinct proteins [5].

Another current trend in applications of monolith focuses on narrow bore open tubular columns with a monolithic porous polymer layer and their use in both CEC and nanoLC [6,7]. This approach enables use of long, very narrow bore capillary columns. For example, a 4.2 m long, 10 µm I.D. column with a poly(styrene-co-divinylbenzene) layer enabled excellent separation of protein digests.

The last example of the emerging applications is use of monolith as a thin layer for the TLC separation [8]. Formation of a monolith on the top of a glass plate is again very simple. A mold consisting the support plate, a gasket, and a top plate is filled with the polymerization mixture and irradiated with UV light. The layer can be immediately used not only for the traditional separation of small molecules but also for the separation of peptides and proteins. The detection is then achieved using MALDI MS.

The above lines are supposed to give the reader a glimpse of the wealth of formats and applications of current porous monoliths. It is very likely that they will further grow in the future since more and more scientists are recognizing the beauty, versatility, and simplicity of these materials.

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Preface to Special Topic: "Papers from the 2006 Annual Meeting of the American Electrophoresis Society, San Francisco, CA" by Adrienne R. Minerick and Victor M. Ugaz, *Biomicrofluidics* **1**, 021501 (2007).

Abstract:

This Special Topic section of *Biomicrofluidics* is dedicated to original papers from the 2006 Annual Meeting of the American Electrophoresis Society (AES: http://www.aesociety.org). This five-day meeting held in San Francisco, California, included five sessions on BioMEMS and Microfluidics and four sessions on Advances in Electrokinetics and Electrophoresis. AES and its corresponding symposia provide the most focused and well-organized meeting forum for diverse biological and engineering researchers working on electrokinetics. The work featured in this Special Topic section is no exception; it ranges from nanochannel electrophoresis to bioparticle sorting.

It is our pleasure to present a selection of papers highlighting some of the outstanding work presented at the recent 2006 symposia of the American Electrophoresis Society !AES", held 12–17 November, 2006 in San Francisco, California. The AES symposia takes place every year in conjunction with the annual meeting of the American Institute for Chemical Engineers !AIChE". By bringing researchers from diverse academic and industrial backgrounds together with AIChE's engineering-based membership, a truly unique format is created that enables cross fertilization of ideas, forging of new professional interactions, and catalyzing of new interdisciplinary collaborations.

AES is a professional society dedicated to the theoretical and practical development of electrokinetic technologies including those using gels, capillaries, and microfluidic chips. The Society was founded in 1973 to promote excellence in science and techniques across all disciplines, and is run by a dedicated group of volunteers from biology departments, medical schools, engineering departments, and the biotech industry. No other U.S. organization is more focused on the important fields of electrokinetics and electrophoresis, which are key components of many genomic analysis assays. This year's meeting featured a look toward the future, with an emphasis on theoretical and experimental advances in bio-MEMS and microfluidic technologies. These breakthroughs are already playing a central role in enabling the development of next-generation bioanalytical devices. The particularly diverse nature of this year's program, including sessions in the areas of cellular, genomic, and proteomic analysis, makes it a natural fit with the scope of *Biomicrofluidics*—a journal aimed at a similarly diverse readership.

The plenary sessions have always been a high point of the AES symposia, and 2006 proved to be no exception. This year, four plenary speakers joined us representing a cross section of the current state-of-the-art in the field. Contributions in the bio-MEMS area included a talk on "Ultrafast Electrophoresis at the Nanoscale using Atomic Force Microscopy" by National Academy of Engineering member, Dr. H. Kumar Wickramasinghe, who was at the IBM Almaden Research Center prior to becoming The Henry Samueli Endowed Chair at University of California, Irvine.

Dr. Robin H. Liu from CombiMatrix Corp spoke on "Integrated Microfluidic and ElectraSense Microarray Biochips for DNAAnalysis," while Dr. Paul Bohn from the University of Notre Dame enthralled the audience with "Nanofluidics and Mass-Limited Chemical Analysis: Nanocapillary Array Membranes as Switchable Fluidic Elements for Multidimensional Analyses." In conclusion, Dr. Lawrence Grossman captured the attention of everyone with "Automated Computational Analysis of Molecular Evolution: Mitochondrial ATP Synthase in Primates and Other Mammals."

Selecting only a few representative papers from such an outstanding program proved to be a particularly daunting task, but we hope that this Special Topic section captures a few highlights of the 2006 AES Symposia. A meeting review by Adrienne Minerick and Victor Ugaz is included, along with the following contributions:

- • Enid N. Gatimu, Travis L. King, Jonathan V. Sweedler, and Paul W. Bohn on "Three-dimensional integrated microfluidic architectures enabled through electrically switchable nanocapillary array membranes";
- • I-Fang Cheng, Hsien-Chang Chang, Diana Hou, and Hsueh-Chia Chang entitled, "An integrated dielectrophoretic chip for continuous bioparticle filtering, focusing, sorting, trapping, and detecting."

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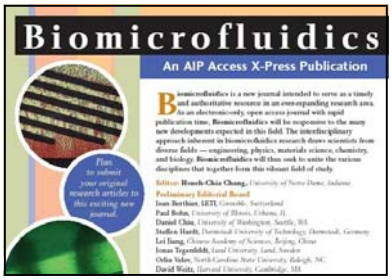
We would like to extend special thanks to the National Institutes of Health (NIBIB), and in particular, Dr. Brenda Korte, for providing funding that allowed us to award expense grants to a selection of truly outstanding student and postdoctoral presenters at the Symposia. These kinds of awards play an instrumental role in helping to prepare the next generation of scientists and researchers to tackle new problems in cutting edge areas. We are also grateful to Professor Hsueh-Chia Chang for generously offering us the opportunity to share a sampling of our technical program with the readers of *Biomicrofluidics*. If you like what you see, we hope you will consider joining us at the 2007 AES Symposia to be held 5–9 November 2007 in Salt Lake City, Utah. A summary of the 2006 technical program and related information can be found on the AES website: (http://www.aesociety.org) and the AIChE website (http://www.aiche.org).



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Join AES now for $75 and receive a combined 2007-2008 membership! Just go to: www.aesociety.org/apply/apply_online.php to join online.

The early registration deadline for the meeting is Oct 1, 2007. To register, just download the registration form at http://www.aiche.org/Conferences/AnnualMeeting/index.aspx and submit by fax or by mail. Don't forget to check the "AES member" box! Note that the registration fee is $560 for members and $830 for nonmembers for the full meeting, and $280 (members) versus $410 (nonmembers) for 1 day only. By joining the AES for $75 you'll save $195 for the full meeting or $55 for 1 day only. *As an incentive, the AES board has agreed that anyone joining AES or renewing after Aug 1, 2007 will receive a full 2008 membership as well.*

Announcement: One Councilor Needed! Make your voice heard - stand for election this fall!

Because Victor Ugaz replaced Scott Rodkey as Vice President, three councilors were elected last year instead of two. See the October 2006 newsletter for details. So this year only one council position is up for renewal, that of Adrienne Minerick.

Many thanks to our Councilor
Adrienne Minerick
Mississippi State University

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.

NIH travel grants are not available this year because of the tight federal budget. However, the 2008 meeting organizers are hopeful. Inquire early next year.

This will be good: →

T3000 Field Trip to the Center of Excellence for Biomedical Microfluidics at the University of Utah: Our Center is dedicated to the discovery, understanding, and commercialization of microscale and MEMS devices for application to biological, biomedical, and medical problems. Come along on the field trip and see what we're about. Sign up for item T2 ($15.00) on the registration form to reserve a slot.