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AES Newsletter

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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

Take time from that busy schedule to plan for the upcoming AES meeting in Salt Lake City!

Update from our Meeting Organizers:

We are pleased to announce that the 2010 annual AES meeting will be held at the Salt Palace Convention Center in Salt Lake City, Utah in conjunction with the annual meeting of the American Institute of Chemical Engineers (AIChE). As a new feature this year, AES is sponsoring the two-part Sunday morning and afternoon workshop on electrokinetics described on page 3 of this newsletter. The AES sessions are designated Topical 3 in the AIChE schedule and consist of 8 contributed sessions, 1 poster session, and 1 invited plenary session running from Monday, November 8 through Wednesday, November 10. Plenary session descriptions are on page 4. The detailed program grid is presented as an insert in this newsletter and is also available at, http://aiche.confex.com/aiche/2010/webprogram/T3.html. *The early registration deadline is September 27th; the registration form can be found at the AIChE website,* http://www.aiche.org/Conferences/AnnualMeeting/index.aspx. Remember that membership in AES qualifies for the discounted membership rate and can be checked on the PDF version of the registration form. The Poster Reception is scheduled for Tuesday, Nov 9, while the AES Banquet will take place on Wednesday, Nov 10 at Buca Di Beppo. Tickets for the AES banquet can be purchased along with your AIChE registration or on-site at the meeting. We look forward to seeing you there.

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AES 2010 Meeting Co-Chairs

Particle Transport in Ordered Geometric Arrays: Separation and Capture

by James P. Smith, Jason P. Gleghorn, and Brian J. Kirby *Cornell University, Ithaca, NY*

Porous materials have been used for years, in membrane form for size-based filtration, and in bulk form as separation media. Porous material is often inexpensive, and control of pore size, surface-to-volume ratio and surface chemistry lead to engineered performance in size selection, separation retention, electrokinetic properties, and transport. Porous material ranges from disordered (packed polydisperse particles, phase-separated polymer monoliths [Svec 2003]) to ordered (hexagonally close-packed monodisperse spheres), and the term "porous" has been applied to a wide range of materials, including packed particles, gels, woven and nonwoven fibers, and nuclear track-etched films.

Despite many successes, the nature of bulk fabrication of porous materials has certain limitations. In particular, while bulk processing affords statistical control of geometric parameters, such as the average and distribution of pore sizes or particle-particle correlation functions, these bulk techniques are limited in their ability to control details of the arrangement of the solid phase. Thus, although bulk materials will always be the choice for those applications for which they excel, lithographic generation of custom porous material will be used when detailed engineering design leads to a marked improvement in performance.

The development of lithographic fabrication techniques has enabled countless microfabricated arrays designed to reproduce and improve upon the performance of porous materials, with varied applications including chemical separation and particle capture. While lithographic fabrication is typically more expensive than bulk processing, the materials that result are amenable to detailed analysis [Kirby 2010] and have the potential for device performance significantly higher than that of traditional porous media.

As one example, microfluidic obstacle arrays have been used to demonstrate fractionation of heterogenous particle populations by filtering particles or by inducing size-dependent trajectories. As the obstacle array structure can be well defined, flow parameters and array geometry can be defined to separate a particle population into multiple sub-populations based on size by inducing size-dependent transverse displacement [Huang 2004; Balvin 2009; Long 2008].

Similar principles can be applied to optimize the design of immunocapture devices. Rather than inducing transverse displacement, size-dependent trajectories can be used to bring target cells into contact with immunocoated surfaces [Gleghorn 2010]. Interactions between the target cell and the immunocoated obstacle surfaces are maximized, while interactions with other species with different particle size are minimized; taken together, these lead to enhanced capture efficiencies and sample purities.

One application of this technique is the capture of rare cells from blood, such as circulating tumor cells (CTCs) in cancer patients or fetal cells in maternal blood. Circulating tumor cells are the putative cause of metastatic lesions, and their enumeration is used for clinical prediction of patient survival. Despite the rarity of CTCs (as few as 1 per 10^9 healthy hematologic cells), devices that combine size-dependent particle trajectories in lithographically patterned obstacle arrays have demonstrated capture efficiencies of 85% and sample purities of 62% [Gleghorn 2010].

References

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AES Workshop Instructor
Electrokinetic Transport
in Microfluidic Devices
(see page 3)

Announcing *two* American Electrophoresis Society Workshops scheduled for Sunday, November 7, 2010 in Salt Lake City!

A morning workshop will focused on the theory and fundamentals of electrokinetics transport in microfluidics devices. An afternoon hands-on COMSOL workshop will provide instruction on how to solve four different problems in electrokinetics using numerical simulation. See below for more information. Don't forget to sign up for the workshops when you register for the meeting.

Electrokinetic Transport in Microfluidic Devices

Sunday Morning Workshop, November 7th, 9:00 AM - 12:00 PM

This workshop covers fluid mechanical transport processes commonly observed in microfluidic devices. Topics include unidirectional flow, hydraulic circuits, transport, and nonlinear electrokinetic fluid flow and particle actuation. Coverage comprises a subset of the material in "Micro- and Nanoscale Fluid Mechanics: Transport in Microfluidic Devices," by Brian J. Kirby, Cambridge University Press, 2010.

Workshop Instructor: Dr. Brian Kirby www.kirbyresearch.com Director, Micro/Nanofluidics Laboratory, Sibley School of Mechanical and Aerospace Engineering at Cornell University.

What you will learn: This workshop session will focus on electrokinetic fluid flow and particle actuation. Experimental equipment will available in the room, and it will be used to perform demonstrations in real time.

Who should attend: researchers in the field of microfluidics, biomedical and chemical engineers, industrial R&D engineers, chemists, biochemists, university professors and students.

Fee: Professors $249; Students and post-docs $149; Undergraduates $10. **Fees include afternoon workshop.**

Microscale Electrokinetics with COMSOL

Sunday Afternoon Workshop, November 7th, 1:00 PM - 4:00 PM

This 3-hour workshop will closely follow the morning workshop. The instructor will provide copies of the latest COMSOLv4.0a numerical simulation software, including a two-week temporary license, and work through four example problems from the morning session on electrokinetic transport in micro/nano-fluidic devices.

Workshop Instructor: John Dunec, Branch Manager of COMSOL **www.comsol.com**

What you will learn: This workshop session will walk attendees through the use of COMSOL for solving problems from the morning workshop on electrokinetic transport in microfluidic and nanofluidic devices.

A personal computer is recommended so that attendees can load the COMSOL software and use it during the workshop.

Who should attend: researchers in the field of microfluidics, biomedical and chemical engineers, industrial R&D engineers, chemists, biochemists, university professors and students.

Fee: $75 for those not registered for the morning workshop.

Absolutely do *not* miss the AES Plenary Session on Monday Nov 8 in Salon III of the SLC Hilton Center featuring five Notable Speakers!

Electrokinetic Locomotion by Reaction Induced Charge Auto-Electrophoresis (3:15 pm)

Dr. Jonathan Posner
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Non-Coalescence of Oppositely Charged Drops (3:45 pm)

Dr. Bill Ristenpart
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Ion Conservation and its Consequences for Electro-Osmosis and Electrophoresis (4:15 pm)

Dr. Todd Squires
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A New Quantitative Molecular Detection Platform for Field Applications (4:45 pm)

Dr. Chia Chang
University of Notre Dame
Chemical Engineering
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Studying Host-Pathogen Interactions with Single-Cell Resolution (5:15 pm)

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