



Notes from the Chair

Dear Friends,

As we begin this new year, and I start my term as MESD Chair, I would like to welcome the increasing numbers of members we have seen these past few years – MESD is growing! In 2008, we hope to continue to strengthen our membership base and involve both our experienced and new members in the strong materials science programming efforts that are the hallmark of MESD, and in building and serving the materials science community within the AIChE. Don Baird (Va.Tech), as our First Vice Chair, is heading the programming efforts of the Division for the 2008 Annual Meeting in Philadelphia; I am sure many of you will hear from him as the program for 2008 is organized and finalized.

I would like to thank our outgoing officers who have worked so hard to further improve and develop our Division! Thanks in particular go to Brian Mitchell (Tulane U.), our outgoing Chair, who not only led our division well during a period of growth, but has also taken on new responsibilities by engaging with the American Chemical Society in joint programming with MESD for the New Orleans Spring meeting – something new and exciting that should strengthen ties across disciplinary societies that are important to nurture! Brian continues to serve the Division and Executive Committee as Past Chair. I would also like to thank outgoing Directors Buddy Ratner (U. Washington) and Tom Keuche (U. Wisconsin), and our outgoing Secretary/Treasurer, Steve Gehrke (U. Kansas) for all of their hard work.

Congratulations to our newly elected

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officers from this past Fall's election! The new officers include Ed Seebauer (U. Illinois) as the new Second Vice Chair, Doug Kalika (U. Kentucky) as our new Secretary/Treasurer, and our newly elected Directors, Sharon Glotzer (U. Michigan) and Alon McCormick (U. Minnesota). We very much look forward to working with our new executive committee members on the upcoming efforts of the MESD. This year we had double the number of members participating in the electronic election, indicating the increasing participation that our membership is taking in the activities of the MESD.

One of the areas of great discussion amongst the MESD Board has been membership. We would like to find out from you whether MESD is meeting your needs and expectations as a programming division. It would be great to hear from you, our members, about how or whether the MESD might become a more dynamic representation of its membership, whether there are means by which we might engage broader participation and membership, and how the MESD impacts your professional endeavors. Two of our MESD Directors, Eric Lin (NIST) and Joel Fried (U. Cincinnati), will be heading efforts to survey our membership this year, and I encourage you to be responsive in the survey and let us know what we are doing well and what we could be doing differently! Those who wish to work on this effort or to send suggestions may Eric Lin at eric.lin@nist.gov.

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Application Deadline for 2008 Charles M.A. Stine Award

The deadline for this year's Charles M. A. Stine Award in Materials Engineering and Sciences is **February 15th**. The award is given to recognize outstanding contributions by members of the AIChE to the scientific, technological, educational, or service areas of Materials Engineering and Science. The \$1500 award is sponsored by E.I DuPont de Nemours and Company and is to be presented at the AIChE Plenary Session. Selection criteria include:

1. Nominations must be submitted by members of the Materials Engineering and Sciences Division; however, the only requirement for the nominee is that he/she must be an AIChE member.
2. Applications must be received no later than Feb 15th
3. The award can be given to an individual or a team
4. Is given for significant discoveries, important research, development of new products or processes, outstanding service to the materials community, education concepts, or initiation of new materials and management.

Additional information, including previous winners of this award, can be found on the AIChE website at www.aiche.org/awards. Under the "Select Award Category", click on Division Awards; the Stine Award is listed under MESD. If interested please contact Dennis W Hess:

William W. LaRoche, Jr. Professor
School of Chemical & Biomolecular Engineering
Georgia Institute of Technology
311 Ferst Drive
Atlanta, Georgia 30332-0100

dennis.hess@chbe.gatech.edu
404.894.5922

We have also made some recommended changes to the MESD Bylaws which are meant to simplify the bylaws, update some of the language in the bylaws, while at the same time opening and clarifying roles of officers, executive committee membership and means by which subcommittees are appointed and maintained. Many thanks go to Alon McCormick, Sue Ann Bidstrup, and many of the past chairs who worked with them to recommend changes. The most significant and impactful change will be the inclusion of a representative of each of our five programming Areas – typically the Area Chair or Vice Chair currently involved in programming of the upcoming year's meeting – as a member of the Executive Committee. By directly incorporating the Area Chairs as voting members of the Executive Committee, we hope to introduce more involvement from the core of our programming efforts, the Areas, and to enable more opportunity for interdisciplinary collaboration on the activities of the Division. The active programming Areas of MESD are: Area 8a (Polymers), Area 8b (Biomaterials), Area 8d (Ceramics), 8e(Electronic Materials) and 8f(Nanocomposites).

The new bylaws will be presented to the membership for electronic voting in the near future – please also stay tuned for this important opportunity to impact the leadership organization of the Division. It is my hope that in the process

of voting on the bylaws, more of you will become familiar with the way in which MESD is organized, and some of you may be interested in future involvement with the programming Areas or the Executive Committee.

Along with looking at ways to create a cohesive community amongst our membership, I am also interested in hearing from you about issues of cohesive programming for future meetings and enhanced collaboration between programming Areas, and ways of introducing educational workshops in new areas to the MESD programming efforts. Your comments on these and other issues are welcome – I'd be happy to hear from you. In the meantime, please continue to encourage membership amongst your co-workers, research group members, and new people entering the field – their added voices will provide future strength and direction to our division.

Paula T. Hammond
MESD Chair, 2008
hammond@mit.edu
617-258-7577

2007 Fall Annual Meeting Highlights

The 2007 Fall Annual Meeting was held at the Salt Palace Convention Center in Salt Lake City on November 4-9. MESD programming was once again strong, with 52 primary sessions.

Plenary Session

The MESD 2007 Plenary Session Lecture was presented by Dr. Michael Tsapatsis of the University of Minnesota. His presentation entitled "Hierarchical Nano-Manufacturing of Zeolite Membranes" was followed by invited talks from Mark E. Davis, Lynn Loo, David S. Sholl and Samir Mitragotri. Tiby Leib of Du Pont Engineering presented Michael with the Charles M.A. Stine Award plaque and check. The session was chaired by Dennis Hess and co-chaired by Brian S. Mitchell.

Executive Committee Meeting

The MESD Executive Committee Meeting was held on November 6 from 4:00 – 6:00 p.m. (See the draft of Executive Committee Meeting minutes on page 4). New officers were introduced, including Ed Seebauer (Second

Vice-Chair), Sharon Glotzer and Alon McCormick (Directors), and Douglass Kalika (Secretary/Treasurer). The main topic of discussion was an update to the division by-laws.

Sue Ann Bidstrup-Allen presented the changes to the committee. Alon McCormick has been working on these changes with past chairs and key members of the Executive Committee. A draft of the proposed changes will be distributed to the membership for approval in 2008. Updates on the joint 2008 AIChE/ACS Meeting in New Orleans and the 2008 Fall Annual Meeting in Philadelphia were provided by the programming chairs, Brian S. Mitchell and Don Baird, respectively.

Poster Session

Fifty-five posters were presented at the MESD Poster Session on Wednesday, November 7. 2007 Programming Chair and rising MESD Chair Paula Hammond arranged for refreshments and snacks, which were well-received by not only the MESD Poster Session participants, but those from concurrent poster sessions as well. The winners of the poster session awards and summary of the posters are on page 6.

2007 Secretary/Treasurer's Report

The attached information provides the details and summaries of the financial transactions and membership activity for the 2006-2007 membership year of the MESD. These include 2006 Council minutes, membership analysis figures and 2006-07 MESD account activity table.

The Division's financial resources decreased by \$2,278.32 in the past membership year (August 2006 - July 2007), although this resulted from the fact that \$5,237.10 in checks issued in 2006 did not show up on the monthly AIChE Revenue & Enhancement statements during that membership year. Considering the income and expenses for the current year only, income outpaced expenses by \$2,958.78. As of the end of the 2006-2007 membership year (July 31, 2007), the Division had a cash balance of \$2,546.30 in its checking account and \$32,080.17 held by AIChE Headquarters, for total cash assets of \$34,626.47. The income and expense items are detailed in the attachments. The major expenses were the Stine and poster awards and annual meeting expenditures. This included approximately \$1200 for beverage service organized by Jeff Koberstein associated with the 2006 MESD Poster Session. Although this expense was not sponsored by industry, MESD investment income is more than sufficient to cover this expense; members' dues are not used this activity. As has been the policy for the last several years, the Division is charged for elections and for A/V rental for its sessions at meetings. The Division is also now responsible for covering the expenses of MESD representatives to the spring meeting planning session. The main sources of income are investment income, dues and corporate donations. From du Pont, \$3,500 was received for the 2006 Stine Award session (award and plenary speakers' honoraria) and from ChevronPhillips, \$1,000 was received to fund the 2006 MESD poster

session. These same funds have been received for the 2007 meeting, with the du Pont funding arranged by Dennis Hess and the ChevronPhillips funding arranged by Don Baird. The annual dues and investment income should be able to cover these expenses without cutting into the MESD principal.

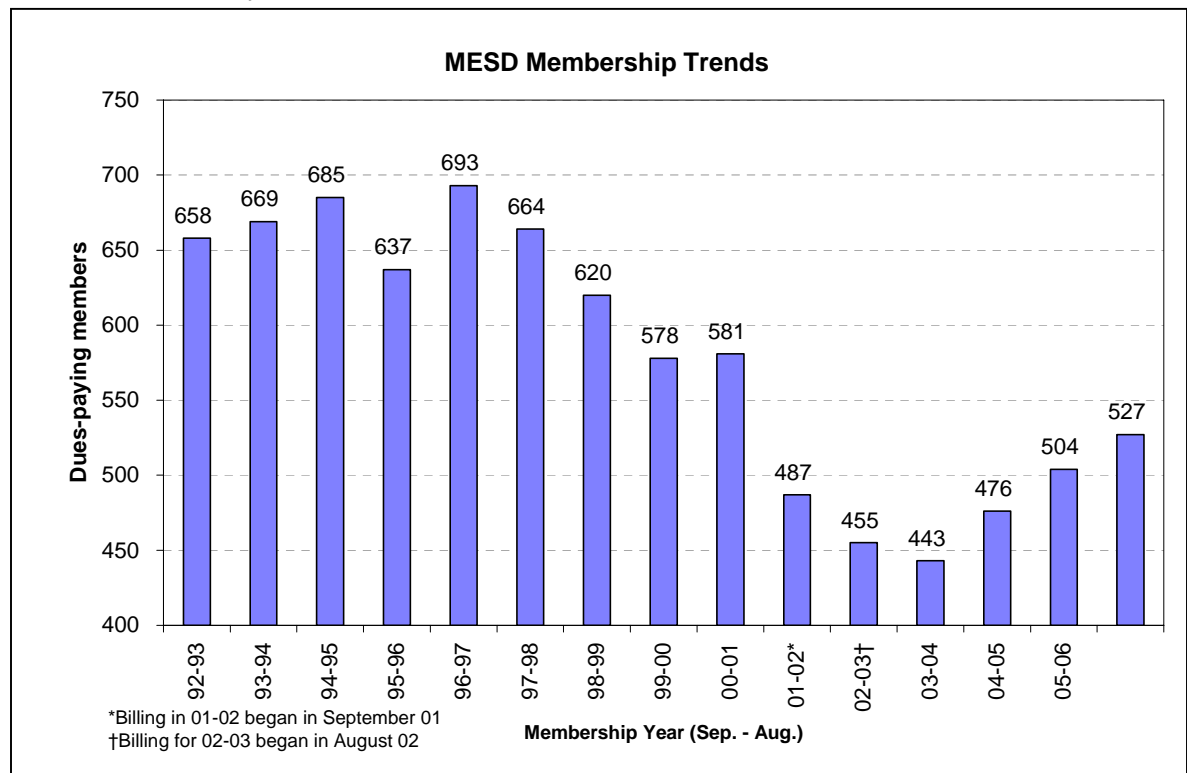
MESD membership rose modestly for the third consecutive year, increasing by 23 to 527 dues-paying members for the 2006-07 membership year, the highest total since 2000-01. However, there were a number of reduced-dues or non-dues paying members included in this total. The total dues-paying membership equivalent is 506, a couple more than last year.

It has been my privilege to serve the MESD as Secretary/Treasurer for the past 15 years. With the submission of this report, I am turning over the responsibilities of this office to Doug Kalika of the University of Kentucky. Doug has provided excellent leadership to the MESD in the past and will make an excellent Secretary/Treasurer.

Respectfully submitted,

Steve Gehrke

Dr. Stevin H. Gehrke
University of Kansas
Secretary/Treasurer, MESD



Materials Engineering & Sciences Division of the American Institute of Chemical Engineers

EXECUTIVE COUNCIL MEETING MINUTES - DRAFT

List of Attendees:

Canyon Room B, Hilton Hotel, Salt Lake City, UT 4:00-6:00 PM, Tuesday, November 6, 2007

E-mail	Name	Affiliation	2006-07 Office
jk1191@columbia.edu	Jeff Koberstein	Columbia U.	Past Chair
SueAllen.Bidstrup@chbe.gatech.edu	Sue Ann Bidstrup-Allen	Georgia Tech	Bylaws Subcommittee
eseebaue@uiuc.edu	Ed Seebauer	U. Illinois	2 nd Vice Chair Elect
pete.ludovice@chbe.gatech.edu	Pete Ludovice	Georgia Tech	Webmaster
brian@tulane.edu	Brian Mitchell	Tulane Univ.	Chair
dbaird@vt.edu	Don Baird	Virginia Tech	2 nd Vice Chair
hammond@mit.edu	Paula Hammond	MIT	1 st Vice Chair
sagarwal@mines.edu	Sumit Agrawal	Col. Sch. Mines	
dennis.hess@chbe.gatech.edu	Dennis Hess	Georgia Tech	Stine Award Chair
ekerdt@che.utexas.edu	John Ekerdt	U. Texas	CTOC Liaison
l-shea@northwestern.edu	Lonnie Shea	Northwestern U.	Area 8b Chair

1. Approval of Agenda – B. Mitchell

The agenda was circulated prior to the meeting and already approved via email.

2. Announcements – B. Mitchell

The following upcoming meetings were announced: Area Programming Meetings, 6-7 p.m. tonight; Stine Award Lecture, 8:30 – 11:00 a.m. tomorrow; and MESD Poster Session and Reception, 4:30 – 6:30 p.m. tomorrow.

3. Stine Award Update – D. Hess

D. Hess informed the division that the candidates for the Stine Award continue to be strong and that he is careful to encourage runners-up to re-submit for the award in subsequent years. Next year's process begins in February with nominations due by February 15. The Stine Award session

continues to be well-attended. Having no MESD technical sessions at the same time as the award lectures on Wednesday morning helps.

4. Approval of Minutes - B. Mitchell

Seeing as how the minutes of the 2006 MESD Executive Council Meeting were approved at the May, 2007 Executive Committee Meeting Teleconference, the minutes of the teleconference were reviewed and corrected (see attached). The minutes as corrected were approved.

5. Election Results - B. Mitchell

Election results were announced and the following new officers introduced: Ed Seebauer, Second Vice-Chair; Doug Kalika, Secretary/Treasurer; Sharon Glotzer and Alon McCormick, Directors. Participation in electronic voting approximately doubled (47) from last year, but is still low. Several email reminders are recommended to improve participation.

6. Draft of MESD Bylaws - S. Bidstrup-Allen

S. Bidstrup-Allen reported on the draft bylaws updated by A. McCormick, who consulted with several past chairs in its development. The revised and updated bylaws must be approved by the membership according to the current bylaws, which call for a 2/3 majority of those responding. The number of respondents must be at least 10% of the division membership, which is currently 527, thereby requiring 53 respondents. J. Koberstein questioned whether or not these revisions had to go to the membership for approval. There was general agreement that although some of the changes were editorial, there were substantive changes that would require membership approval.

Discussion of each proposed change in the bylaws ensued, and a revised document was created (see attached). Of particular import to the changes is the proposed inclusion of area chairs as voting members of the Executive Committee. While there was general support for the idea, there was some concern that it would be increasingly difficult to obtain the necessary 50% of the Executive Committee voting members to constitute a quorum for meetings.

There was also discussion on how to proceed with the approval process from this point. B. Mitchell suggested, and it was approved, that the revisions to the draft be incorporated, and forwarded to rising Chair P. Hammond for distribution to the current Executive Committee for approval via email. Past chairs and members of the revision committee would also be copied as a courtesy. Upon approval of the Executive Committee, the document will be sent to the national organization for posting, and a special electronic ballot for its approval initiated.

The Executive Committee thanked A. McCormick and S. Bidstrup-Allen for their efforts and service.

7. Treasurer's/Membership Report - B. Mitchell for S. Gehrke

The Secretary/Treasurer's report was delivered (see page 2). Division dues are stable, with current assets of \$34,626.47. Division membership has increased over the past four years and currently stands at 527 members. J. Ekerdt questioned who constituted "reduced" or "non-dues paying" members, and requested that the Secretary/Treasurer clarify this statement. B. Mitchell will relay this request to S. Gehrke.

S. Gehrke was thanked in absentia by the Executive Committee for his years of service to the Division.

8. 2007 Fall Annual Meeting Update - P. Hammond

P. Hammond reported that MESD was sponsoring 52 sessions at this meeting. A few originally-proposed sessions were combined to achieve this number. B. Mitchell asked about the number of co-sponsored sessions. P. Hammond stated that she did not have that number, but would get it. The estimated cost of the Poster Session reception is \$1,000, but the exact amount will depend on how the tickets are used; i.e., for beer or for mixed drinks.

9. 2008 Spring Meeting Update - B. Mitchell

There will be two co-sponsored sessions at the joint AIChE/ACS Spring meeting in April, chaired by B. Grady and M. Hu of MESD. These sessions represent the first programming MESD has done at the Spring Meeting in some time.

10. 2008 Fall Annual Meeting Update - D. Baird

The 2008 Fall Annual Meeting will be in Philadelphia. Area programming meetings will be held after the Executive Committee meeting. D. Baird questioned the need for a morning joint programming meeting, and suggested that he could just meet with the area chairs after their meetings this evening. He will then set a deadline of Dec. 1, 2007 for submission of proposed sessions by the area chairs. The sessions will then be submitted to the national programming committee prior to the Spring meeting.

J. Ekerdt announced that there are three themes for the 2008 Annual Meeting, one of which is energy. He encouraged programming in this area.

11. Website Update - P. Ludovice

The conversion of MESD web content to the national service is almost complete, though the amount of time required to update and maintain the content is inordinately larger than for the current website at Georgia Tech. The CMS Series 400 software is complicated and crashes often.

12. Newsletter Update - B. Mitchell

The newsletter continues to be issued three times a year to the membership.

13. Additional Items from the Committee

An Email letter from Director E. Lin was briefly

discussed, in which he offered his services to conduct a membership survey regarding benefits. The Executive Committee thanked him for his offer. P. Hammond will contact both him and J. Fried regarding the survey.

B. Mitchell mentioned that the Nanoscale Science and Engineering Forum (NSEF) conducted a successful Webinar this past year, and suggested that the new Directors S. Glotzer and A. McCormick may be interested in organizing one for MESD.

14. Installation of New Chair – B. Mitchell

B. Mitchell turned the meeting over to P. Hammond. J. Koberstein thanked B. Mitchell for his service to the Division.

15. Adjournment

The meeting was adjourned at 6:00 p.m.

Minutes recorded by Brian S. Mitchell, MESD Chair

2007 MESD Poster Award Winners

Each poster winner received a check and certificate from the MESD Division. The poster session contest and awards were sponsored by Chevron Phillips Chemical Company. We are very grateful to Chevron Phillips for the continued support of the poster session competition, as it has added an excellent opportunity to recognize the talent in the Division. Special thanks also go to Dr. Ashish Sukhadia of Chevron Phillips for his stewardship for the Division.



Upcoming Meetings and Events

AIChE has its spring meeting April 6-10th in New Orleans, LA.

AIChE has its national meeting November 16-21th in Philadelphia, PA.

This year's upcoming Stine Award Nominations are due February 15th, 2008.

New Carbon Allotropes Produced By Hydrogen Plasma Exposure Of Carbon Nanotubes

Michael J. Behr¹, Tejinder Singh², Dimitrios Maroudas², and Eray S. Aydil¹. (1) Department of Chemical Engineering and Materials Science, University of Minnesota, Minneapolis, MN 55455, (2) University of Massachusetts, Department of Chemical Engineering, Amherst, MA 01003

Group-IV nanostructured materials, such as hydrogenated nanocrystalline silicon (nc-Si:H), hydrogenated nanocrystalline germanium (nc-Ge:H), diamond, silicon carbide, and carbon nanotubes, find numerous applications ranging from solar cells to filters, heat sinks, field emitters, high-power RF semiconductor devices, molecular electronics, and more recently as biological or chemical sensors. One common technique used to grow these technologically important materials is plasma-enhanced chemical vapor deposition (PECVD), whereby reactive chemical species created in the plasma react on a surface to yield a thin film. It has been well established that hydrogen plays a critical role in determining the crystallinity of these nanostructured materials. For example, the ability to deposit diamond thin films from hydrocarbons heavily diluted in hydrogen has been studied extensively. Another example is the transformation of amorphous silicon films to nanocrystalline ones upon exposure to atomic hydrogen. Recently, we have shown that

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crystallization of amorphous silicon is mediated by the insertion into strained Si-Si bonds of H atoms as they diffuse through the film.¹ Concerted rearrangements of the bonds in the vicinity of the insertion reaction lead to a hydrogen-induced amorphous-to-crystalline transformation.^{1,2} Based on the hypothesis that this chemically-induced crystallization mechanism could be operative in other covalently-bonded solids, we have exposed multiwalled carbon nanotubes (MWCNTs) and carbon nanofibers (MWCNFs) to atomic hydrogen produced by an inductively coupled radio frequency plasma source. Indeed, we observed hydrogen-induced crystallization of MWCNTs and MWCNFs at room temperature. Nanometer-size crystals of carbon appear gradually during 2-10 hour H-atom exposure of the nanotubes. We characterized these nanocrystals using high-resolution transmission electron microscopy (HRTEM), electron diffraction, and forward recoil elastic spectrometry (FRES). HRTEM of the H-exposed material at room temperature revealed the presence of carbon nanocrystals, ~5 nm in diameter, embedded in amorphous carbon nanorods. The electron diffraction patterns and lattice spacings could not be accounted for by known crystalline phases of carbon, such as diamond and lonsdaleite, or by contaminants. However, two distinct crystalline phases are observed among a variety of others in this amorphous matrix. The observed electron diffraction patterns and lattice spacings from these two phases are consistent with a body-centered cubic (BCC) phase with lattice parameter $a = 0.30$ nm and a face-centered cubic (FCC) phase with lattice parameter $a = 0.425$ nm. The lattice parameter of the FCC phase is approximately the same as that of i-Carbon, a previously observed but unidentified phase belonging to the cubic crystal system. However, electron diffraction from i-Carbon and the FCC phase we observe do not follow the same selection rules. First-principles density functional theory calculations within the generalized gradient approximation are used in conjunction with electron microscopy to suggest possible crystal structures for these new phases. Specifically, we consider the possibility that these new ordered phases may contain hydrogen atoms in addition to carbon and examine the dependence of the structural parameters of the crystalline phases on their hydrogen content.

¹S. Sriraman, S. Agarwal, E. S. Aydil, and D. Maroudas, *Nature* **418**, 62 (2002).

²S. Sriraman, M. S. Valipa, E. S. Aydil, and D. Maroudas, *J. Appl. Phys.* **100**, 053514 (2006); M. S. Valipa, S. Sriraman, E. S. Aydil, and D. Maroudas, *J. Appl. Phys.* **100**, 053515 (2006).

Nafion® Nanofibers And Their Effect On Polymer Electrolyte Membrane Fuel Cell Performance

Joshua D. Snyder, Chemical and Biomolecular Engineering, Johns Hopkins University, 3400 North Charles Street, Baltimore, MD 21218 and Yossef A. Elabd, Chemical and Biological Engineering, Drexel University, 3141 Chestnut Street., Philadelphia, PA 19104.

Current fuel cell research is focused on reducing manufacturing costs by reducing platinum catalyst loading without sacrificing performance. Although improvements have been demonstrated by using platinum supported on porous carbon nanoparticles (Pt/C), significant losses in “active” platinum surface area within the electrode or catalyst layer (CL) still occur. Optimizing the reactant gas/Nafion®/platinum triple phase boundary (TPB) in the CL (i.e., CL morphology) will result in increased “active” catalyst area and overall fuel cell performance. In this study, the effect of temperature on the formation of Nafion® nanofibers in the CL during fuel cell operation and its subsequent improvement on fuel cell performance was clearly characterized. Post mortem scanning electron micrographs clearly show that Nafion® nanofibers improve the TPB by increasing porosity, “available” platinum surface area, while Nafion® nanofibers act as a more efficient proton transport route from the catalyst particles to the polymer electrolyte membrane. Further improvements to the TPB was demonstrated by fabricating Nafion® nanofibers prior to fuel cell testing. These new CLs were developed by electrospinning a copolymer solution of Nafion® and poly(acrylic acid) with catalyst particles (Pt/C) and also reducing Pt salts on electrospun Nafion®/poly(acrylic acid) nanofibers. Micrographs confirm an improved TPB compared to standard CLs. The hydrogen fuel cell performance and optimization of these new nanofiber/nanoparticle CLs and their stability within a fuel cell will be presented.

Astrocytic Growth on Silicone Catheters with Different Hydrophobicities in a Model of Pulsatile Cerebrospinal Fluid Flow

Carolyn A. Black, Bioengineering, University of Utah, 20 S 2030 East, 506 Biopolymers Research Building, Salt Lake City, UT 84112, William E. Grever, Children's Research Center of Michigan, Department of Pediatrics, School of Medicine, Wayne State University, 3L35, Detroit, MI 48201, K. Y. Simon Ng, Department of Chemical Engineering and Materials Sciences, Wayne State University, 5050 Anthony Wayne Dr., Detroit, MI 48202, and James P. McAllister II, Department of Neurological Surgery, Wayne State University, 4201 Antoine Street, UHC-6E, Detroit, MI 48201.

While silicone catheters have vastly improved a wide array of medical treatments, reactions at the tissue/substrate interface often diminish their functionality. In the treatment of hydrocephalus, implanting a silicone catheter in the cerebral ventricles allows cerebrospinal fluid to be drained from the cranial cavity to an alternative

absorption site, usually the abdominal cavity. While this “shunt” controls intracranial pressure and improves neurological outcome, the catheter system is highly susceptible to blockage because the silicone interface is attractive to cells, primarily astroglia. Our previous in vitro experiments have shown that increases in hydrophobicity, caused by polymer immobilization on silicone, can inhibit cell adhesion. In the present study, the hydrophobicity of silicone catheters was further investigated in an ex vivo model of cerebrospinal fluid flow through a catheter. Using a pulsatile flow apparatus at 0.3 mL/min, 3×10^6 astrocytes (46,153 astrocytes/mL) were exposed for 20 hours to the lumen of native (contact angle measurement of 107.4°) and oxidated silicone (contact angle measurement of 0°), OD 2.5 mm and ID 1.3 mm. Catheter samples were analyzed by 2-photon confocal microscopy and cytospin methods. The observed trend in this fluidic culture study was an increase in astrocyte adhesion on native silicone when samples were held horizontally. Likewise, an increase in astrocyte adhesion occurred on oxidated silicone but only when samples were held vertically. Furthermore, a significant difference ($p < 0.05$) between native and oxidated silicone was observed in the bottom half of the horizontal tubing, a region prone to astrocytic settling. When compared to standard cell culture preparations of astrocytes on silicone, these results were noticeably dissimilar. The results of this study provide a better understanding of the effects of pulsatile flow on astrocytic growth and should lead to the identification of novel surface modification strategies to improve long-term implantation of silicone catheters.

MESD Officers

Chair

Paula T. Hammond
Massachusetts Institute of Technology
617.258.7577
hammond@mit.edu

Second Vice Chair

Edmund Seebauer
University of Illinois
217.333.4402
eseebaue@uiuc.edu

Directors (term ends 2009)

Sharon Glotzer
University of Michigan
734.615.6296
sglotzer@umich.edu

Alon McCormick
University of Minnesota
612.625.1822
mccormic@cems.umn.edu

First Vice Chair and Program Committee Chair

Donald G. Baird
Virginia Tech
540.231.5998
dbaird@vt.edu

Secretary-Treasurer

Douglass Kalika
University of Kentucky
859.257.5507
kalika@engr.uky.edu

Directors (term ends 2008)

Eric K. Lin
NIST
301.975.6743
eric.lin@nist.gov

Joel Fried
University of Cincinnati
513.556.2790
joel.fried@uc.edu

Past Chair

Brian S. Mitchell
Tulane University
504.862.8257
brian@tulane.edu

Webmaster

Pete Ludovice
Georgia Institute Of Technology
404.894.1835
pete.ludovice@che.gatech.edu

Newsletter Editors

Brian S. Mitchell
Tulane University
504.862.8257
brian@tulane.edu

Matt Stefanick
Caterpillar Inc.
309.578.4835
stefanick_matt@cat.com