

# TPM&F

## Thermoplastic Materials & Foams Division

A divisional newsletter of the Society of Plastics Engineers



Volume 1  
2010/2011  
September Issue

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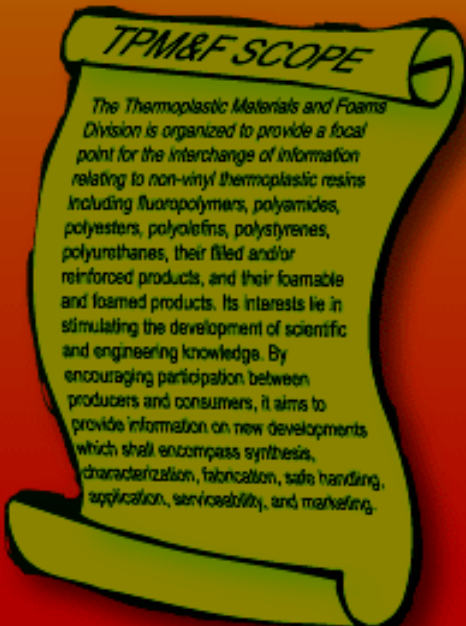
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### CHAIRMAN'S MESSAGE



Hello again to everyone! I hope that you have all had an enjoyable summer.

Once again, the TPM&F Board of Directors has been hard at work on your behalf to bring you new and interesting technical content and to improve and make more timely communication between the TPM&F Board of Directors and members.

A three part webinar series on foam technology basics is already in progress with 33 individuals signed up for all three. To help keep the costs down for members, SPE headquarters and TPM&F each contributed \$25 per attendee to keep the cost at \$150 for the entire series. Please look for a follow-up series starting in January on polyolefin basics. For more information on either series, please contact Perry Vadhar.

The foams webinar series is a perfect lead-in for the upcoming FOAMS®2010 Tutorial and TopCon occurring September 28 - October 1 at the Crowne Plaza Hotel in downtown Seattle, Washington, USA. Attendance numbers are already growing for both the tutorial and the TopCon; hopefully, you will be able to attend. Presently, there will be seven student poster presentations, 16 presentations, 1 keynote speech and two plenary speeches. The technical program and student paper listing may be found elsewhere in this newsletter. I must also thank the several sponsors for their support of FOAMS®2010; please see the sponsor listing, also found elsewhere in this newsletter. If additional information is needed, please e-mail or call Kelvin Okamoto.

The TPM&F BOD has started soliciting papers for two technical sessions at the Polyolefins 2011 TopCon in Houston, Texas, USA at the end of February 2011. The two session topics are Polyolefins in Non-Woven Fiber Applications (*session developer Donna Davis*) and Processing and Applications of Polyolefins (*session developer Ananda Chatterjee*); if you have interest in speaking on either subject, please contact either Donna or Ananda.

The planning for ANTEC™ 2011 in Boston has started with the abstract and paper submission process already in progress. Hani Naguib, TPM&F's Technical Program Chairperson for ANTEC™ 2011, is seeking excellent technical papers for presentations and posters. Please contact Hani or SPE headquarters if you are interested in presenting a paper.

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# BOARD OF DIRECTORS

AS OF MAY 30, 2010

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To improve communication, the TPM&F Board has started a LinkedIn subgroup called Thermoplastic Materials & Foams under the SPE group; if you are a member of LinkedIn, please request membership in the subgroup to participate in discussions regarding topics of interest to TPM&F members and to get up-to-date information from the TPM&F Board of Directors. TPM&F members will also start to receive e-mail updates on an as needed basis of new benefits, technical content or others items of interest to TPM&F members; these e-mails will be issued no more than once a month.

Hopefully, it is obvious that the TPM&F Board of Directors has been working hard to improve the value of your SPE and TPM&F membership. Please let us know what else we can do to even further improve the value.

Sincerely,

*Kelvin J. Okamoto*

*Chairman, Thermoplastics Materials & Foams Division, SPE*



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## MEET YOUR NEW BOARD MEMBERS

### DONNA DAVIS



Donna Davis was introduced to the SPE, and specifically the TPM&F Division, in the early 80's by a customer. She's been an active member ever since, valuing specifically the technical interactions with other members. She has held most of the BOD positions in the Division, from newsletter editor (*when the 2500 letters were manually addressed*) to ANTEC™ TPC and Chair. After serving as the TPM&F Councilor, she was elected to SPE offices, including President of the Society.

Based on her personal experience with SPE, she continues to champion the development and distribution of technical information amongst the membership. Most recently, she has been working with a small group from the BOD to plan and deliver webinars built around the key themes of TPM&F: *FOAMS®* (preceding the 2010 *FOAMS®* Conference); Olefinic polymers (preceding the 2011 *Polyolefins* Conference); and Engineering Thermoplastics (for which we need a conference!). Donna served as the TPC for ANTEC™2010 and currently chairs the ANTEC™ General TPC.

Donna has worked for Exxon Mobil (and Exxon before) since the 70's, specifically in the Chemicals organization since 1981. Currently assigned to Global Marketing/Strategic Market Research, most of her Chemicals career has been associated with olefinic polymers. She managed the specialty polymer technology group, focused on early metallocene products and high-pressure PE specialties such as VA and acrylate copolymers and ionomers. Prior to that, she supported the broad portfolio of Exxon Chemical Company products to the packaging industry, both flexible and rigid. She has published in the area of new products and structures for film applications, blow-molding, thermoforming, and extrusion coating.

Donna is a Certified New Product Development Professional and a Plastics Pioneer. She majored in Chemical Engineering at the University of Tennessee and LSU, and studied Engineering, Technology, and Marketing Management through the Cal Tech Industrial Relations Center.

### MAXWELL WINGERT



Maxwell Wingert is currently employed in research & development at Procter & Gamble. He obtained his doctorate in chemical engineering from Ohio State University in 2007. His interests involve polymer foam, extrusion, and bioplastics.

Since 2007, he has been an active part of the Thermoplastic Materials & Foams Division Board of Directors, serving on the following committees: *FOAMS®*2008, *FOAMS®*2009, *FOAMS®*2010, Outstanding Achievement Award, Communications, and Education. He became the division treasurer in July 2010. His interests include the stock market, landscaping, music, football, and my lovely wife, Amanda.

## BEST PAPER AWARDS

CONTRIBUTED BY LUKAS STINEMANN

The best paper awards for ANTEC™ 2010 go to the following under their respective categories. Congratulations to our winners!

### FOAMS CATEGORY

Paper Title:

EXTRUSION FOAMING OF POLYSTYRENE/ACTIVATED CARBON/CARBON NANOPARTICLES USING CARBON DIOXIDE/WATER BLOWING AGENT

Authors: Cailiang Zhang, Bin Zhu, Thomas Danil, Yong Min, L. James Lee,  
AUTHORS AFFILIATIONS: Department of Chemical and Biomolecular Engineering, The Ohio State University, Columbus, OH 43210, USA  
Nanomaterial Innovation Ltd, Columbus, OH 43212, USA

### ABSTRACT

Extrusion foaming using supercritical carbon dioxide (CO<sub>2</sub>) is the most economic and environmentally benign process but it is difficult to control the foam density and maintain the thermal insulation performance. In this study, we added water as a co-blowing agent to better control foam density and introduced carbon nanoparticles/activated carbon (AC) to improve the thermal insulation performance of polystyrene (PS) foam. In order to understand this novel extrusion foaming process, the effects of various parameters such as particle style and content, extruder barrel and die temperatures on foam density, morphology and thermal insulation performance are investigated systematically.

### THERMOPLASTICS CATEGORY

Paper Title:

DEPENDENCE OF CRACK-TIP TEMPERATURE ON STRESS INTENSITY AND NOTCH-SENSITIVITY OF POLYETHYLENE TEREPHTHALATE

Authors: Bernard Chukwuemeka Ogazi-Onyemaechi, Yew Wei Leong, Hiroyuki Hamada

AUTHORS AFFILIATION: Advanced Fibro Science, Kyoto Institute of Technology, Matsugasaki, Sakyo-ku, 606-8585 Kyoto, Japan.

### ABSTRACT

During tensile loading, the temperature of notched materials is correlated to the applied stress and its resultant strain. At crack propagation, the strain energy that is released, or work done during deformation, affects the temperature at the crack tip and the yielding axis. The intensity of the temperature is seen to depend on the notch depth and stress intensity at the notch root. In this investigation, an infrared camera was used to monitor the temperature distribution around the crack axis during the tensile loading of notched PET specimens. The correlations between the temperature distributions at the crack-tip, notch sensitivity and essential work of fracture were established. Results reveal that the one of the major fracture mechanism that increases temperature is a mixed mode fracture. This occurs when crazing precedes semi-ductile/brittle fracture. It was observed that the highest change at the notch root temperature occurred in samples where the notch depths are located at the interface between the skin and the core regions.

## NEXT BOARD MEETING:

WEDNESDAY, SEPTEMBER 29, 2010

5:30 - 8:00 PM

The Crowne Plaza, Downtown Seattle.

This meeting will be held at the Crowne Plaza Hotel, Downtown Seattle in the 5th floor meeting room and by audio conference.



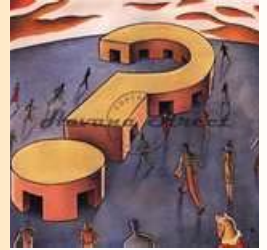
*As a note, an hors d'oeuvres welcoming member's reception will be held just prior to this meeting from 4:00 - 5:30 PM.*

For those attending the Board Meeting please R.S.V.P. to [Kto4SPE@mac.com](mailto:Kto4SPE@mac.com)

## EDUCATION CHAIR REPORT - PERRY VADHAR

Following our discussion at ANTEC™ 2010, the team members (*Donna Davis, Michael Reedy, Theresa Healy, Elizabeth Regan and Perry Vadhar*) have finalized the plan to offer the first webinar series

on foams. Several of our Board members including Dr. Chul Park, Dr. Hani Naguib, Michael Reedy and Theresa Healy have volunteered their time to make presentations at the webinar series.



This three-part SPE e-Live® Webinar, co-produced by the TPM&F Division, will be offered in August and September prior to the FOAMS®2010 Conference. The series will cover the following topics:

- Part 1: Thermoplastic Foam Industry Overview--Past, Present, and Future - Aug. 5, 2010
- Part 2: Foams: Fundamentals on Materials and Processing - Aug. 26, 2010
- Part 3: Bio and Sustainable Foams -- Sept. 16, 2010

The presenters for each topic are shown below:

- Part 1: Michael Reedy and Theresa Healy, Reedy International
- Part 2: Chul Park, University of Toronto
- Part 3: Hani Naguib, University of Toronto

SPE Headquarter and the TPM&F Division have jointly agreed to offer the webinar series at reduced cost. The standard cost for the series was reduced from \$199 to \$149. The TPM&F Division will contribute \$25/participant from the education fund. The SPE Headquarter will reduce their charges by \$25.

Our first webinar was on August 5 and it has gone well. There were 33 participants who took advantage of the webinar series. Some of them joined from Europe and S. Korea. This is a very good start for our first ever webinar series. Thanks to the team members and support from Professors Dr. Park and Dr. Naguib for making this series successful.

## EX-TREASURER'S REPORT - WEN WU

Summary as of May 30, 2010 (preliminary)  
Thermoplastic Materials and Foams Division BOD

### Financial Summary

- Division finance is healthy.
- TPM&F Account balance at year-end of FY2010 (6/30/10) was \$145,687, up by \$3,590 compared to a balance of \$142,097 at the same period in FY2009 (6/30/09).
- FY2010 revised budget: Income \$17,050, expense \$25,900 for a net deficit of \$8,850.
- FY2010 actual income was \$18,013 and actual expense was \$14,422 for a net surplus of \$3,590.

It's been my pleasure to have served as the Division treasurer for the past 9 years. Maxwell Wingert assumes the Division treasurer position as of 7/1/2010.



# FOAMS® 2010 TUTORIAL

## SEPTEMBER 28-29, 2010

Instructors: Dr. H. E. Naguib Dr. C.B. Park/Dr. T. Kuboki Dr. N.S. Ramesh

Co-sponsored by the TPM&F Division and Pacific Northwest Section of the Society of Plastics Engineers

### PURPOSE & REVIEW

This tutorial will provide practical information that will help you enhance your technical capability in foaming. It will help you develop new blowing agents to meet the growing challenges, design foam products that meet customer's needs, improve effectiveness of your foam R&D and processing projects. The attendee will also receive updated key references on plastic foams.

### WHO SHOULD ATTEND?

This tutorial is intended for a range of companies and individuals involved in thermoplastic foam development, production, and applications:

1. R&D scientists and engineers, formulation scientists, process engineers, quality engineers and application engineers from thermoplastic foam production and manufacturing companies.
2. Chemists and chemical engineers involved in development of foaming grade resins and blowing agents.
3. Foaming equipment manufacturing: design engineers, project engineers, and rheology specialists.
4. Development engineers and research scientists working on new foam developments.
5. Foam users and application specialists.

### FOR HOTEL INFORMATION:

<http://www.cphotelseattle.com/index.php>

For hotel reservations:

<https://resweb.passkey.com/go/FOAMS2010>

### FEES

SPE Member Fees (*Advance by Sept. 10, 2009*):

- \$ 375 Advance / \$ 575 On-site for Tutorial
- \$ 450 Advance/ \$ 650 On-site for Conference
- \$ 725 Advance/ \$ 925 On-site for both Tutorial and Conference

SPE Non-Members: (*Advance by Sept. 10 2009*):

- \$ 575 Advance / \$ 775 On-site for Tutorial
- \$ 650 Advance/ \$ 850 On-site for Conference
- \$ 925 Advance/ \$ 1,125 On-site for both

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### ABOUT THE INSTRUCTORS

**Dr. Hani Naguib** is an Associate Professor at the University of Toronto and holder of a Canada Research Chair Tier II in Smart and Functional Polymers. His major expertise is in the area of multi-functional polymers including active polymers; biopolymers and polymer composites. He has more than 120 refereed publications to date in the field and he has presented more than 100 scholarly addresses and conference presentations. Dr. Naguib is a Professional Engineer in Canada, a Chartered Engineer in U.K. with other professional engineering affiliations. He is the recipient of numerous honors and awards such as the Premier's Early Research Award of Ontario, the Canada Foundation of Innovation, and he is a Fellow of the Canadian Society of Mechanical Engineers. Dr. Naguib got his Ph. D in Mechanical Engineering from the University of Toronto in 2001.

**Dr. Chul B. Park** is a Professor and a holder of Tier I Canada Research Chair in Microcellular Plastics at University of Toronto. He is also the Founder and Director of the Microcellular Plastics Manufacturing Laboratory, which enjoys the reputation of being one of the pioneering research institutions in refining various foaming technologies. As a Fellow of SPE, CAE, EIC, ASME, and CSME, he is an accomplished scientist with international recognition in the field of plastic foaming. Professor Park is the author or co-author of over 500 publications including 20 patents and 190 journal papers. He is also active in professional activities. He is Editor-in-Chief of the Journal of Cellular Plastics and serves as an advisory editorial board member of Cellular Polymers and Advances in Polymer Technology. He has been organizing the Foam Symposia at PPS. He also served on FOAMS® TopCon 2006 and ANTEC™ TPM&F 2008 and 2009 as the Technical Program Chair. He was the Conference Co-Chair for Biofoams 2007 and the Conference Chair for Biofoams 2009. He received his PhD from MIT in 1993.

**Dr. Takashi Kuboki** is the Associate Director of the Microcellular Plastics Manufacturing Laboratory and Centre for Industrial Application of Microcellular Plastics in Department of Mechanical and Industrial Engineering at University of Toronto. His research area includes processing and characterization of biopolymers, biocomposites, polymer nanocomposites, polymer composites, and their foams. Dr. Kuboki received Ph.D. in Kyushu University, Japan. After graduation, he was appointed as Research Fellow of the Japan Society for the Promotion of Science (JSPS), Research Associate in Mechanical Engineering at University of Alberta, and Alberta Ingenuity Industrial Associate.

**Dr. N. S. Ramesh** is the Director of Technology & Innovation, Asia & Foams. He received a B.Tech in Chemical Engineering from Coimbatore Institute of Technology (*University of Madras*), India and M.S. and Ph.D. in Chemical Engineering from Clarkson University, NY. He went through the Summer Rheology Program at MIT, and the executive management programs at University of Michigan (*Ann Arbor*) and SMU Cox (*Dallas*) business schools. Dr. Ramesh has worked in the area of polymeric foams for 19 years and received two best paper awards for his pioneering work on foams from the Society of Plastics Engineers (SPE). He has more than 50 publications including 22 US patents, 2 books and 2 book chapters. The Society of Plastics Engineers (SPE) elected him as Fellow of the Society in 2002 and he served as the Technical Chair for SPE Foams Conference from 1998- 2004. He is the current Past Chairman of SPE's TPM&F Division.



# FOAMS<sup>®</sup>2010

8th International Conference on Foam Processing & Technology  
Co-sponsored by the Pacific Northwest Section & TPM&F Division  
The Society of Plastics Engineers

September 30 - October 1, 2010

Crowne Plaza Hotel • Seattle, Washington, USA

New materials, processes, equipment and foaming agents are being continually developed for foam applications. Interest in finding new polymers and foaming agents for foam applications is one of the top priorities.

## TRANSPORTATION INFORMATION:

There is a light rail train service from SEATAC airport to Downtown Seattle: <http://www.soundtransit.org/Riding-Sound-Transit/Schedules-and-Facilities/Central-Link-Light-Rail.xml> Train stop (*University Street Station*) at downtown is 3 blocks from the hotel on Seneca Street. Fare is 2.50 per person one way. Map and driving directions:

The hotel is at the corner of 6th & Seneca. Valet Only. Link: <http://www.crowneplaza.com/h/d/cp/1/en/hotel/seadt/transportation?start=1>  
Hotel room reservations may be made at the special SPE rate of US\$139/night + taxes by calling or e-mailing:

## CROWNE PLAZA HOTEL

Seattle Downtown Area  
1113 Sixth Avenue Seattle, WA 98101 United States  
1-800-521-2762

For hotel information: <http://www.cphotelseattle.com/index.php>

## For hotel reservations:

<https://resweb.passkey.com/go/FOAMS2010>

Rate applies for single or double occupancy. Cancellation policy is before 72 hours of arrival date or one night room and tax will be charged. Check-in time is 4:00pm and after. Check-out time is by 12 noon.



## FOAMS<sup>®</sup> 2010 COMMITTEE

Conference Chair	Kelvin Okamoto
Conference Co-Chair	Eric Teoh
Tech. Program Chair	M.A. Rodriguez-Perez
<i>Committee Members</i>	
Treasurer - Chris Hall	Raymond Shute
Sponsors - Theresa Healy	Michael Reedy
Posters - Maxwell Wingert	Sal Monte
Charlie Pratt	

## ON-SITE REGISTRATION

Wednesday, September 29	2:00 p.m. - 5:00 p.m.
Thursday, September 30	7:00 p.m. - 6:00 p.m.
Friday, October 1	7:00 a.m. - 12:00 p.m.

## FOAMS<sup>®</sup>2010 GOLD Sponsors:

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# FOAMS<sup>®</sup>2010 Program

DAY 1: THURSDAY, SEPTEMBER 30, 2010

## Session 1:

### Sustainable, Biodegradable & Environmental Foams


- 8:00 **Welcome Address** - Kelvin Okamoto
- 8:05 **Program Outline & Plenary Speaker Introduction** -  
*Miguel Angel Rodriguez-Perez, University of Valladolid, Spain*
- 8:15 **Plenary Address**  
Sustainable Material & Product Testing and Certification  
*K. Okamoto, Green Bottom Line, USA*
- 9:15 Long Term Performance of Insulating Foams  
*S. Costeux, Dow Chemical, USA*
- 9:45 Rheology and Extrusion Foaming of PHBV  
*D. Szegda, S. Duangphet, J. Song, K. Tarverdi, Brunel University, UK*
- 10:15 Expanded Polylactide (E-PLA): A Realistic Approach to Expanded Polystyrene  
*J. F. Gasancher, A. Fernyhough, Scion, New Zealand*
- 10:45 **COFFEE BREAK & EXHIBITS OPEN** 
- 11:15 Advancements in Chemical Foaming Agent Technology to Improve the Sustainability of Plastic Applications.  
*Frank Neuber, Clariant Corporation, USA*
- 11:45 PVT Solubility Behaviours of CO<sub>2</sub>/N<sub>2</sub> Blends in PS Melts  
*M. M. Hasan, G. Li, C. B. Park, and P. Chen, University of Toronto, Canada*
- 12:15 **LUNCHEON** Keynote Speaker  
Making Operations Green: Owens Corning's Gold LEED<sup>®</sup> Foam Manufacturing Plant  
*John McClellan, Owens Corning, USA*

Student Posters: There are seven student posters that will be up throughout the conference. There will also be three local students helping the conference out with registration and setup thanks to Xiaoxi Wang of the Pacific Northwest Section. See page 9 for poster list.

## Session 2:

### Innovation in Foams & Foaming Technology 1

**Moderator: Michel Dumon, University of Bordeaux**

- 2:00 The Science of Foaming Olefin Block Copolymers  
*K. Kummer, J. M. Rego, C. Bette, D. Wang, M. Subramanian, The Dow Chemical Company, USA*
- 2:30 Recent Developments in Foam Extrusion by the Use of Flexible Retrofit Components  
*C. Schlummer, N. Ulicney, Sulzer, Switzerland*
- 3:00 **COFFEE BREAK & EXHIBITS OPEN** 
- 3:30 A Novel Method to Analyze the Foamability of Polymer Systems using In-Situ Optical Expandometry and Radioscopy  
*M.A. Rodriguez-Perez, E. Solorzano, J. Pinto, J.A. de Saja, University of Valladolid, Spain*
- 4:00 New Polyester Resin: SPG-PET  
*K. Maruo, Mitsubishi Gas Chemical, USA*
- 5:30 to 7:30 **EXHIBITOR'S RECEPTION & STUDENT POSTER SESSION**

## REGISTRANTS:

**PLEASE JOIN US WEDNESDAY SEPTEMBER 29 FOR:  
Opening Reception with hors d'oeuvres:  
4:00 - 5:30 PM**



**TPM&F BOD Meeting:  
5:30 - 8:00 PM**



# FOAMS®2010 Program

DAY 2: FRIDAY, OCTOBER 1, 2010

## Session 3:

### Micro and Nano Foams & Nanocomposites

Moderator: Chul Park, University of Toronto

8:00 **Plenary Address**

Synthesis, Processing and Properties of Polymer Nanocomposites Foams  
*J.L. Lee, Ohio State University, USA*

9:00 Effect of Nanoclay on the Cell Morphology and Crystallization Behavior of Polylactic acid during Extrusion Foaming  
*W. Zhai, C.B. Park, University of Toronto, Canada*

9:30 Thermal Conductivity of Microcellular ABS  
*S. Liu, V. Kumar, University of Washington, USA*

10:00 Thermal Behavior of Microcellular Polycarbonate Foams  
*M. Rohleder, A.K. Bledzki, H. Kirschling, University of Kassel, Germany*

10:30 **COFFEE BREAK & EXHIBITS OPEN**



11:00 Low Density Nanocellular Foams Fabricated by Supercritical Carbon Dioxide  
*J.A. Reglero, M. Dumon, University of Bordeaux, France*

11.30 LDPE Silica Nanocomposites: A System in Which the Nanoparticles Play a Multifunctional Role  
*C. Saiz-Arroyo, J. Escudero, M.A. Rodriguez-Perez, University of Valladolid, Spain*

12:00 **LUNCHEON - Awards and Presentations**

## Session 4:

### Innovation in Foams & Foaming Technology 2

Moderator: N.S. Ramesh, Sealed Air

1:30 Foaming Behavior, Structure and Physical Properties of a Novel Benzoxazine Resin  
*M.Ardanuy, JI Velasco, M.A. Rodriguez-Perez, Polytechnic University of Catalunya, Spain*

2:00 The Sulzer Process: Access to Innovative Particle Foam Solutions for the EPS Industry  
*P. Nising, L. Stirnemann, Sulzer, Switzerland*

2.30 **Closing Remarks** - Kelvin Okamoto

## REGISTRATION FORM

### FOAMS® 2010

Thursday-Friday, September 30 - October 1, 2010  
Crowne Plaza Hotel, Seattle, Washington, USA

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# FOAMS® 2010 STUDENT POSTER SESSION

Conference Sept. 30 - Oct. 1, 2010  
Tutorial September 28-29

*Student Poster Session Technical Program  
(September 30, 5:30pm to 7:30pm):*

1. The Effects Of Crosslinking On Elastomer Foaming, N. Chen\*, T. Kuboki, and C. Park from University of Toronto, Canada

2. Foaming Of EVA/Starch Blends: Characterization Of The Structure, Physical Properties And Biodegradability, R. D. S. Guerino\*, M.A. Rodriguez-Perez, S. Roman-Lorza, M. Alvarez-Lainez, C. Montoya-Mesa, C. J. L. Constantino, and J.A. de Saja from Universidade do Oeste Paulista, Brazil, University of Valladolid, Spain, and Eafit University, Columbia

3. Extrusion Foaming Of PHBV Using EU Food Approved Chemical Blowing Agent, S. Duangphet\*, D. Szegda, J. Song, and K. Tarverdi from Brunel University, UK

4. Improvement Of Mechanical Properties Of Polyurethane Composites: Recycled Particles As Fillers, S. Estravís Sastre\* and M. Á. Rodríguez-Pérez from University of Valladolid, Spain

5. The Effect Of Cell Gas Pressure On The Compressive Properties Of Microcellular RPET Foams, J. Hanks\*, V. Kumar, X. Wang, K. Nadella from University of Washington, USA and MicroGREEN Polymers, Inc.

6. A Comparison Of Solubility And Diffusivity Of CO<sub>2</sub> In PC And ABS In The Microcellular Foaming Process, H. Guo\*, J. Weller, K. Nadella, and V. Kumar from University of Washington, USA

7. Combination Shear-Compression Testing Of Foams For Their Application In Bicycle Helmets, K. VandenBosche\* and K. Verjans from Katholieke Universiteit Leuven, Belgium

## PHOTOS FROM ANTEC™ 2010 CEREMONY



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L-R: Kelvin Okamoto, TPM&F Chair; Ashu Sharma, TPM&F Councilor; Paul Anderson, SPE Past President; Donna Davis, TPM&F board member and former SPE President.



N.S. Ramesh, TPM&F Past Chair, accepts Honored Service Member Award.  
L-R: Paul Anderson, N.S. Ramesh.