

127th Annual



**AUTOMOTIVE  
COMPOSITES  
CONFERENCE  
& EXHIBITION**

*World's Leading Automotive Composites Forum*

**SOCIETY OF PLASTICS ENGINEERS  
AUTOMOTIVE & COMPOSITES DIVISIONS**

*Unleashing*  
the POWER of Design



SEPTEMBER 11-13 2012



# Celstran® CFR-TP

## Continuous Fiber Reinforced Thermoplastics

### Study of Unidirectional Tapes for Improved Underbody Shield

#### Stiffness and Impact-Enhanced Composites

Glass/polypropylene underbody shield compression molded\* via tailored D-LFT process with additional reinforcement from woven tape fabric and tailored blank laminate, both produced with Celstran CFR-TP unidirectional tapes.

#### Benefits of Hybrid Thermoplastic Composite Molding

- Incorporate flowability and cost-effectiveness of D-LFT
- Improve stiffness, strength and impact performance with continuous fiber reinforced thermoplastic composites
- Maintain performance while reducing wall thickness and part weight
- Improve performance while maintaining wall thickness

### Solutions for Metal Replacement and Weight Reduction

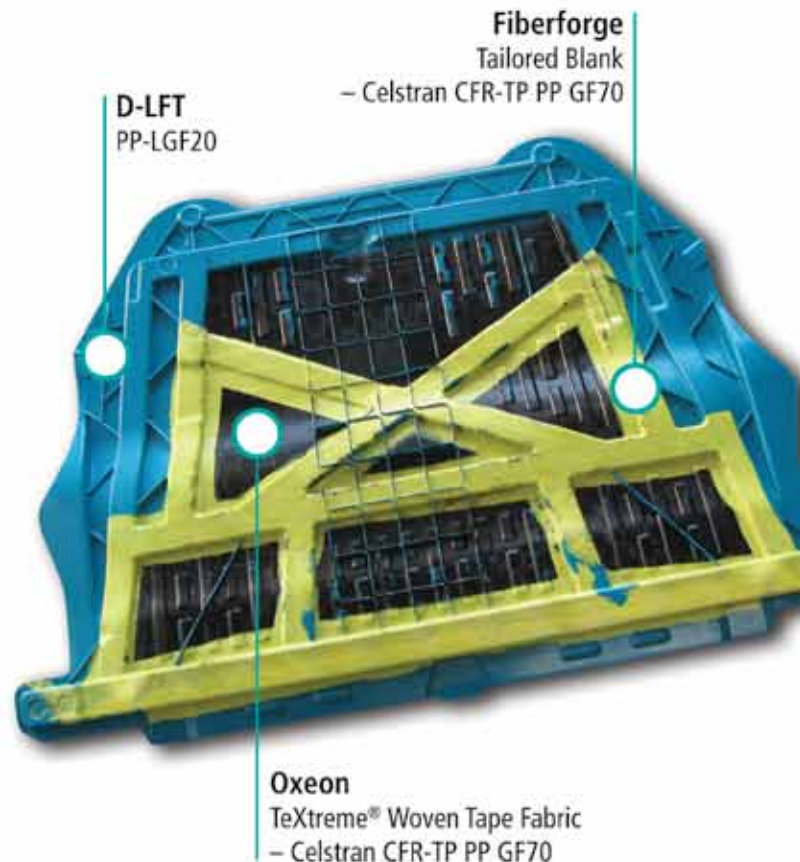
The definition of lightweight is changing every day, and the demand for materials that provide superior performance has never been greater. Celstran® CFR-TP from Ticona delivers:

- Low weight with high strength and stiffness
- Superior dimensional and thermal properties
- Facilitates complex designs
- Wide range of resins and fiber reinforcement technologies to match your design requirements
- Can be combined with long fiber reinforced thermoplastics for localized reinforcement
- Product forms of tapes, rods and profiles

For additional technical and application information visit: [www.ticona.com/composites](http://www.ticona.com/composites) or call 1.800.833.4882

Ticona Engineering Polymers  
8040 Dixie Highway, Florence, KY 41042

\* High-volume production tool generously loaned by Mirinda Schenk Plastic Solutions (Esslingen, Germany). TeXtreme is a registered trademark of Oxeon AB.



# Design With Fortron® PPS. Performance That Goes To Extremes.

**Takes the heat up to 240°C.  
Has no known solvent up to 200°C.**

The toughest design challenges demand extraordinary performance and reliability. For components that can reduce weight, drive down costs and perform in extreme environments, **Fortron PPS** from Ticona delivers... and then some.

- High continuous use temperature (160°C to 240°C)
- Short-term temperature resistance up to 270°C
- Broad chemical resistance – including automotive/aircraft fuels and fluids, strong acids and bases (pH 2 to 12) – even at elevated temperatures
- Superior dimensional stability (low shrink, CTE)
- Excellent creep resistance, especially at elevated temperatures
- Virtually no moisture absorption (~0.02%)
- Potential weight savings up to 50% vs. metals

## Global performance. Global product. Global solutions.

At Ticona, we're much more than advanced materials. We provide total solutions with global reach, local resources, design and application development support, and deep technical knowledge.

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# WELCOME

FROM THE 2012 SPE® ACCE CONFERENCE CHAIR

On behalf of the Automotive and Composites Divisions of the Society of Plastics Engineers, I bid you welcome to the 12<sup>th</sup>-annual Automotive Composites Conference & Exhibition. This year's theme is "*Unleashing the Power of Design.*" As our conference continues to grow, we are excited to present to you the *world's leading automotive composites forum.* We have attracted presenters and attendees from around the globe.

This year we have the largest technical program and the most sponsors and exhibitors in our 12-year history. To accommodate this growth we have expanded the space available for sponsors and exhibitors, and have moved our lunch service outside the building on the north side. Our focus on the utilization of composites in automotive has not changed. Further, we have added two R&D facility tours at the end of our formal sessions that offer an exciting opportunity to see some new and novel technologies that hold the promise of reshaping the composites market.

This year we have:

- Over 70 peer-reviewed technical papers, plus 6 industry-leading keynote speakers
- 2 panel discussions on issues surrounding design, analysis, manufacturing, and assembly of the multi-material vehicle
- Graduate and Undergraduate Poster Sessions
- ACCE Best Paper Awards
- A wonderful array of exhibitors and sponsors
- Our annual cocktail receptions sponsored by Momentive on Tuesday evening and by the Composites and Automotive Divisions of SPE on Wednesday evening
- A new composite parts competition with an award presented during our closing ceremony
- An R&D center tour on Thursday afternoon to Plasan Carbon Composites (Wixom, MI, USA)
- An R&D center tour of the new Fraunhofer Project Centre for Composites Research at Western University (London, ONT, Canada) all day Friday
- And, just as importantly, a small friendly environment that fosters networking with suppliers, colleagues, and customers.

It is an honor to again be the chair of the ACCE for 2012. The planning committee for the ACCE is a volunteer group of industry experts dedicated to the growth of composites and passionate about the automotive business. It is my humble responsibility to be the face of this great assembly of professionals from both the Automotive and the Composites Divisions of SPE. It is a year-long process to bring you the ACCE and requires the dedicated support of our committee.

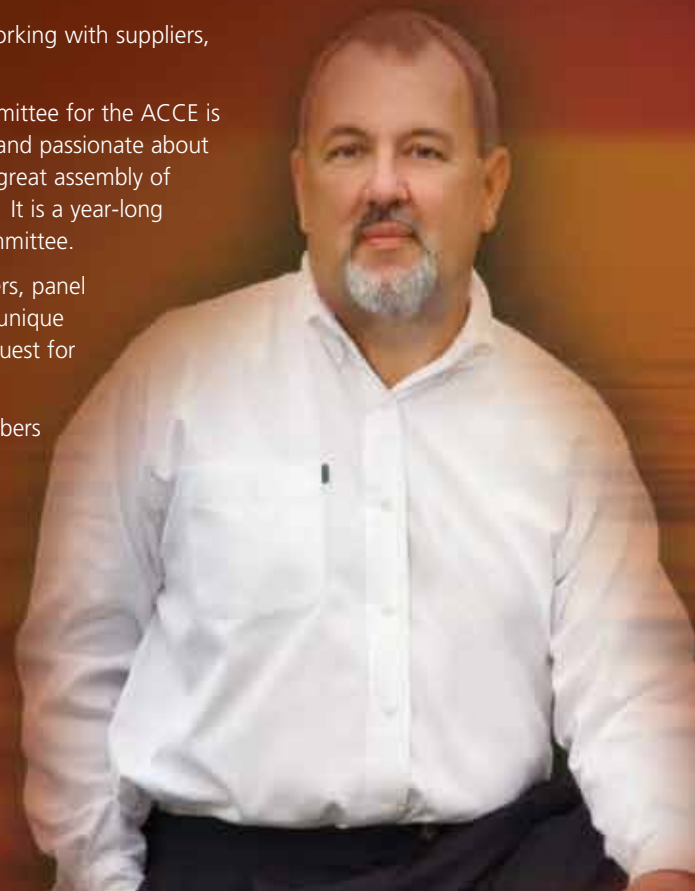
I also want to personally thank all our authors and presenters, keynote speakers, panel members, sponsors, exhibitors, and attendees. Please take advantage of this unique composites conference and the opportunities it presents to help you in your quest for greater utilization of composites!

Enjoy the conference and please contact any of our planning committee members if you have questions or feedback for us.

Kind Regards,

*Creig Bowland*

Creig Bowland  
2011 & 2012 SPE Automotive Composites Conference & Exhibition Chair  
PPG Industries





# CONTRIBUTORS 2012



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SOCIETY OF PLASTICS ENGINEERS  
AUTOMOTIVE & COMPOSITES DIVISIONS

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**Marianne Morgan (Organizer)**  
BASF Corp.

**Lindsay Brooke (Moderator)**  
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Engineering Magazine

**Saad Abouzhar**  
Chrysler Group LLC

**Jay Baron**  
Center for Automotive Research (CAR)

**Oliver Kuttner**  
Edison2

**Gary Lownsdale**  
Plasan Carbon Composites

**Tom Pilette**  
Magna Exteriors & Interiors

**George Ritter**  
EWI

### SIMULATION PANEL DISCUSSION (DAY 2)

**Roger Assaker (Organizer)**  
e-Xstream engineering

**Doug Smock (Moderator)**  
PlasticsToday.com &  
TheMoldingBlog.com

**Roger Assaker**  
e-Xstream engineering

**Fouad el Khaldi**  
ESI Group

**Hannes Fuchs**  
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### Design/Pre-Production:

JPI Creative Group

Signage: That Color

Printing: Synergetics

CDs: N-Code

Pens & Notepads: RTP Company &  
Addcomp North America, Inc.

Bags, Plaques & Lanyards:

Bags sponsored by Ticona

Plaques & trophy sponsored by SPE

Lanyards sponsored by Plasan Carbon

Composites — items provided by

Business Design Solutions

# TUESDAY, SEPT 11

- 6:30–8:15 REGISTRATION - COFFEE IN MEZZANINE  
EXHIBITS OPEN / CONTINENTAL BREAKFAST - Lobby
- 8:15–8:45 OPENING REMARKS (Including Best Paper Awards & Student Scholarship Announcements) **Creig Bowland**, '11 & '12 SPE ACCE Chair, PPG Industries
- 8:45–9:00 COFFEE BREAK / EXHIBITS - Multiple Areas

SEE TIMES  
IN SESSION  
LISTING

	IN AUDITORIUM	IN AMPHITHEATER 101	IN AMPHITHEATER 102
	<p><b>TECHNOLOGY READINESS - PART 1: European Composites Innovations</b></p> <p>9:00–9:40 <b>Lee Harper</b> <i>Nottingham University</i> Advancements in Discontinuous Carbon Fibre Composites for Automotive Applications</p> <hr/> <p>9:40–10:20 <b>Jonah Jimenez</b> <i>Sigmatex High Technology Fabrics</i> A Novel 3D Weaving Process for Low Cost, Complex Carbon Fiber Pre-Forms</p> <hr/> <p>10:20–11:00 <b>Speaker to be Announced</b></p> <hr/> <p>11:00–11:30 <b>Graham Barnes</b> <i>Engenuity</i> Beyond Crash Tubes: Extending Composite Impact Predictions to Adhesively Bonded Energy Absorption Structures</p>	<p><b>COMPOSITES TUTORIAL - PART 1: Introduction to Polymer Composites</b></p> <p>9:00–11:30</p> <p>A full 2½ hours of Tutorials on Thermoset &amp; Thermoplastic Composites Presented by the Automotive Composites Alliance &amp; SPE Composites Division board members</p>	<p><b>VIRTUAL PROTOTYPING &amp; TESTING OF COMPOSITES - PART 1: Best Practices &amp; Fiber Orientation</b></p> <p>9:00–9:30 <b>Mike Wyzgoski</b> <i>American Chemistry Council</i> Long Fiber Reinforced Thermoplastics Predictive Engineering (PE) Activities</p> <hr/> <p>9:30–10:00 <b>Dan Williams</b> <i>Granta Design Ltd.</i> A Structure &amp; Best Practice for the Management of Composites Data in Engineering Design &amp; Materials Selection</p> <hr/> <p>10:00–10:30 <b>John T. Hofmann</b> <i>Virginia Polytechnic Institute &amp; State University</i> The Effect of Glass Fiber Length on Orientation Distribution within Center &amp; End Gated Injection Molded Composites <i>2012 SPE ACCE Scholarship Award Winner</i></p> <hr/> <p>10:30–11:00 <b>Cong Zhang</b> <i>The Ohio State University</i> Discontinuous Long-Fiber Reinforced Composite Processing &amp; Final Part Stiffness Predictions</p> <hr/> <p>11:00–11:30 <b>Kevin Meyer</b> <i>Virginia Polytechnic Institute &amp; State University</i> Current Efforts in Simulating the Injection Molding of Short and Long Glass Fiber Composites</p>
11:30–12:30	LUNCH - North Patio / EXHIBITS - Multiple Areas — JUDGING FOR STUDENT POSTER COMPETITION		
12:30–1:00	KEYNOTE SPEAKER <b>Sebastian Schelper</b> , <i>BMW AG</i> , <i>Affordable Composites for High Volume Production in the BMW i8</i>		
1:00–1:15	COFFEE BREAK / EXHIBITS - Multiple Areas		
1:15–1:45	<p><b>BIO &amp; NATURAL FIBER COMPOSITES - PART 1:</b></p> <p><b>Alper Kiziltas</b> <i>University of Maine</i> Natural Fiber Blends Filled Engineering Thermoplastic Composites for Automobile Industry <i>2012 SPE ACCE Scholarship Award Winner</i></p>	<p><b>ADVANCES IN THERMOSET COMPOSITES - PART 1: Epoxy &amp; Polyurethane</b></p> <p><b>Roman Hillermeier</b> <i>Momentive Specialty Chemicals GmbH</i> Advanced Thermosetting Resin Matrix Technology for Next Generation High Volume Manufacture of Automotive Composite Structures</p>	<p><b>VIRTUAL PROTOTYPING &amp; TESTING OF COMPOSITES - PART 2: Laminate Behavior &amp; Material Models</b></p> <p><b>Ali Al-Sharif</b> <i>Wayne State University</i> The Effect of Low Cycle Compression Fatigue on Composite Sandwich Beams in the Presence of Delamination</p>
1:45–2:15	<p><b>Mehdi Tajvidi</b> <i>University of Waterloo</i> Viscoelastic Properties of Polypropylene/Talc/Wheat Straw Fiber Composites for Automotive Applications</p>	<p><b>Tom McKay</b> <i>BASF Corp.</i> Lightweight Composites: Epoxy-Matrix Materials for Faster RTM Processes</p>	<p><b>Russell Mailen</b> <i>Baylor University</i> Laminate Stiffness &amp; Curvature for Laminated Carbon Fiber Composites, Experimental Observation &amp; Model Validation</p>
2:15–2:45	<p><b>Alper Kiziltas</b> <i>University of Maine</i> Utilization of Carpet Waste as Matrix in Natural Fiber-Filled Engineering Thermoplastic Composites for Automotive Applications <i>2012 SPE ACCE Scholarship Award Winner</i></p>	<p><b>Stephen Misencik</b> <i>SAERTEX USA, LLC</i> All-Composite Transit Bus Body</p>	<p><b>Pedro Cortes</b> <i>Youngstown State University</i> The Fracture Properties of a Fiber Metal Laminate Based on Self-Reinforced Thermoplastic Material</p>
2:45–3:15	<p><b>Jeffrey J. Cernohous</b> <i>Interfacial Solutions, LLC</i> Alternative Natural Fiber Based Automotive Composites</p>	<p><b>Stefan Kreiling</b> <i>Henkel Corp.</i> Polyurethane Matrix Resin Technology: Highly Durable Composites via Cost-Efficient Resin Transfer Molding (RTM) Processes</p>	<p><b>Umesh Ghandi</b> <i>Toyota Motor Co.</i> Study Effect of Unidirectional Tape on Fiber</p>
3:15–3:30	COFFEE BREAK / EXHIBITS - Multiple Areas		
3:30–4:00	KEYNOTE SPEAKER <b>Oliver Kuttner</b> , <i>Chief Executive Officer &amp; Co-Owner, Edison2</i> , <i>Correct Primary Decisions Leading to Positive Feedback Loops</i>		
4:00–5:30	<p><b>PANEL DISCUSSION: Design &amp; Assembly of the Multi-Material Car</b> MODERATOR: <b>Lindsay Brooke</b>, <i>Automotive Engineering Magazine / SAE International</i> PANELISTS: <b>Saad Abouzahr</b>, <i>Chrysler Group LLC</i>; <b>Jay Baron</b>, <i>Center for Automotive Research (CAR)</i>; <b>Oliver Kuttner</b>, <i>Edison2</i>; <b>Gary Lownsdale</b>, <i>Plasan Carbon Composites</i>; <b>Tom Pilette</b>, <i>Magna Exteriors and Interiors</i>; <b>George Ritter</b>, <i>EWI</i></p>		
5:30–7:00	COCKTAIL RECEPTION / EXHIBITS - Ballroom Sponsored by Momentive Performance Materials		



# WEDNESDAY, SEPT 12

7:00–8:00 REGISTRATION / CONTINENTAL BREAKFAST / EXHIBITS - Ballroom  
 8:00–8:15 OPENING REMARKS **Creig Bowland**, '11 & '12 SPE ACCE Chair, PPG Industries  
 8:15–8:30 COFFEE BREAK / EXHIBITS - Multiple Areas

	IN AUDITORIUM	IN AMPHITHEATER 101	IN AMPHITHEATER 102
8:30–9:00	<b>ENABLING TECHNOLOGIES - PART 1: RTM &amp; Sandwich Panel Enhancements</b>  <b>Raman Chaudhari</b> <i>Fraunhofer-Institut für Chemische Technologie</i> Characterization of High-Performance Composites Manufactured by Using High Pressure RTM Process Variants	<b>PREFORMING TECHNOLOGIES - PART 1:</b>  <b>Dan Buckley</b> <i>American GF</i> Preforming can be Fast and Easy	<b>VIRTUAL PROTOTYPING &amp; TESTING OF COMPOSITES - PART 3: Modeling, Simulation &amp; Validation</b>  <b>Suof Omran Abdalslam</b> <i>Wayne State University</i> Modeling Impact Behavior of Glass Fiber Composite with Balsa Core
9:00–9:30	<b>Lolei Karine Khoun</b> <i>National Research Council Canada</i> Effect of Process Variables on the Performance of Glass Fibre Reinforced Composites made by High Pressure Resin Transfer Moulding	<b>Christoph Greb</b> <i>Institut für Textiltechnik of RWTH Aachen University</i> Economic Potential of Single- & Multi-Step Preforming for Large-Scale Production of Automotive Composite Structure <i>2012 Best Paper Award Winner</i>	<b>Vasant Pednekar</b> <i>LANXESS Corp.</i> Simulating Structural Composite Hybrid Parts Made from Continuous Fiber Reinforced Plastics
9:30–10:00	<b>Jan Kuppinger</b> <i>Fraunhofer-Institut für Chemische Technologie</i> Polyurethane Base Sandwich Structures – Face Sheet Characteristics and Part Development	<b>Matthias Graf</b> <i>Dieffenbacher GmbH</i> CFRP - Preform Technology – Advancements in the Fully Automated Preform Process for Complex Parts	<b>Rani Richardson &amp; Jason Curtis</b> <i>Dassault Systèmes &amp; Inceptra</i> Automotive Innovation Takes Flight – Literally
10:00–10:15	COFFEE BREAK / EXHIBITS - Multiple Areas		
10:15–10:45	<b>ENABLING TECHNOLOGIES - PART 2: Injection Molding &amp; Fastening Developments</b>  <b>Joe Gobernatz</b> <i>ATF Inc.</i> New Lightweight Fastening Solution for Thermoplastic Composites Applications	<b>PREFORMING TECHNOLOGIES - PART 2:</b>  <b>Ulrich Mörschel</b> <i>Textechno Herbert Stein GmbH &amp; Co. KG</i> DRAPETEST: Automatic Drapability Tester	<b>VIRTUAL PROTOTYPING &amp; TESTING OF COMPOSITES - PART 4: Modeling, Simulation &amp; Validation (cont'd)</b>  <b>Sejin Han</b> <i>AutoDesk</i> The Numerical Analysis & Validation of Compression Molding Process
10:45–11:15	<b>Joachim Kragl</b> <i>Engel Machinery, Inc.</i> Organomelt & In-Situ Polymerization Provide New Opportunities for Injection Molding of Composite Structures	<b>Nathan Han</b> <i>3D Nanocomposites Inc.</i> Low Cost Hook & Loop 3D Composites Enable Automatic Laying-Up Fabrics for Mass Production Preforming	<b>Roger Assaker</b> <i>e-Xstream engineering</i> Stiffness, Failure & Fatigue of Fiber Reinforced Plastics <i>2012 Best Paper Award Winner</i>
11:15–11:45	<b>Scott Powers</b> <i>Trexel Inc.</i> Foam Injection Molding: Unique Process Solutions for Light Weighting Automotive Plastic Parts	<b>Tommy Fristedt</b> <i>LayStitch LLC</i> Novel Fiber Placement Technologies for Composite Applications	<b>Richard Schaake</b> <i>SKF Engineering &amp; Research Centre</i> Estimation of Anisotropic Stiffening Feature Dimensions in Early Design Phase
11:45–12:45	LUNCH - North Patio / EXHIBITS - Multiple Areas — Announcement of SPE Graduate Poster Competition Awards		
12:45–1:15	KEYNOTE SPEAKER <b>Gary Lownsdale</b> , Chief Technology Officer, <b>Plasan Carbon Composites &amp; Calvin Bamford</b> , President, <b>Globe Machine Manufacturing Co.</b> <i>Cutting Cycle Time for Prepregged Carbon Fiber Composites</i>		
1:15–1:30	COFFEE BREAK / EXHIBITS - Multiple Areas		
1:30–2:00	<b>ENABLING TECHNOLOGIES - PART 3: Combining Discontinuous &amp; Continuous Reinforcements</b>  <b>Manfred Reif</b> <i>Fraunhofer-Institut für Chemische Technologie</i> Multi-Material Design – Lightweight Design for Electric Vehicles	<b>ADVANCES IN THERMOPLASTIC COMPOSITES - PART 1: Polyamides</b>  <b>Manoranjan Prusty</b> <i>BASF SE</i> New PA with Advanced Stabilization & Higher Glass Loading Improves Mechanicals at Elevated Temperatures	<b>ADVANCES IN COMPOSITE REINFORCEMENT TECHNOLOGIES - PART 1: New Options to Improve Mechanical Properties</b>  <b>Andy Rich</b> <i>Element 6 Consulting</i> The Effect of Changing Process, Resin, & Fiber Architecture on Composite Properties
2:00–2:30	<b>Jan-Anders Månson</b> <i>EELCEE AB</i> QEE-TECH™ - Thermoplastic Composites for High Volume Structural Applications	<b>Jonathan Spiegel</b> <i>Polystrand</i> Development of Continuous Fiber Reinforced Nylon Composite for Structural Applications	<b>Juan Serrano, PPG Industries</b> Technological Developments in Fiber Glass Composites for Lightweight Structural Application Solutions
2:30–3:00	<b>Benjamin Hangs</b> <i>Fraunhofer-Institut für Chemische Technologie</i> Co-Compression Molding of Tailored Inserts made from UD-Tape with Directly Compounded Long-Fiber-Reinforced Thermoplastics (D-LFT) <i>2010 SPE ACCE Scholarship Award Winner</i>		<b>Andrew Head</b> <i>A&amp;P Technology</i> Braided Reinforcements Enable Nimble Automation of Composite Molding
3:00–3:15	COFFEE BREAK / EXHIBITS - Multiple Areas		
3:15–4:15	KEYNOTE SPEAKER <b>Jan-Anders Månson</b> , Professor, Director-Laboratory of Polymer & Composite Technology, Ecole Polytechnique Federale de Lausanne <i>Opportunities &amp; Challenges for Automotive Composites</i>		
4:15–5:45	<b>PANEL DISCUSSION: Predictive Analysis of Multi-Material Automotive Structures</b> MODERATOR: Doug Smock, <i>PlasticsToday.com, TheMoldingBlog.com</i> PANELISTS: Roger Assaker, <i>e-Xstream engineering</i> ; Fouad el Khaldi, <i>ESI Group</i> ; Hannes Fuchs, <i>Multimatic Engineering</i> ; Mark Minnichelli, <i>BASF Corp.</i> ; Tim Palmer, <i>MSC Software Corp.</i> ; and Jeff Webb, <i>Ford Motor Co.</i>		
5:45–7:15	COCKTAIL RECEPTION / EXHIBITS - Multiple Areas Sponsored by SPE Automotive & Composites Divisions		

# THURSDAY, SEPT 13

6:30-8:00	CONTINENTAL BREAKFAST / EXHIBITS - Ballroom		
	IN AUDITORIUM	IN AMPHITHEATER 101	IN AMPHITHEATER 102
8:00-8:30	<b>CARBON COMPOSITES - PART 1: Opportunities &amp; Challenges</b> <b>Cliff Eberle</b> <i>Oak Ridge National Laboratory</i> Status of Low-Cost Carbon Fiber Developments	<b>ADVANCES IN THERMOPLASTIC COMPOSITES - PART 2: Polyolefins</b> <b>Kunal Kumar</b> <i>Hanwha Azdel, Inc.</i> Development of a New Light Weight Reinforced Thermoplastic for Automotive Interiors	<b>NANOCOMPOSITES - PART 1: Nanotubes &amp; Nanofibers</b> <b>Carla Leer Lake</b> <i>Applied Sciences Inc.</i> Carbon Nanofiber Composites: From Innovative R&D to Commercial Reality
8:30-9:00	<b>George Husman</b> <i>Zoltek Companies, Inc.</i> Carbon Fiber Composites – Low Cost Materials and Manufacturing Options	<b>Duane Emerson</b> <i>Ticona Engineering Polymers</i> Using Unidirectional Glass Tapes to Improve Impact Performance of Thermoplastic Composites in Automotive Applications <i>2012 Best Paper Award Winner</i>	<b>David Inglefield</b> <i>Virginia Tech</i> Functionalization of Multi-Walled Carbon Nanotubes with Hydrogen Bonding Sites for High Performance Polyurethane Nanocomposites <i>2011 SPE ACCE Scholarship Award Winner</i>
9:00-9:30	<b>Glade Gunther</b> <i>UMECO</i> Dform: Enabling the Use of High Performance Materials in High Volume Applications	<b>Jim Keeler</b> <i>Albis Plastics Corp.</i> Higher Temperature PP-Based Composite Provides Nylon/PA-Level Performance at Lower Weight & Cost	<b>David Lashmore</b> <i>Nanocomp Technologies</i> All CNT Lithium Based Secondary Battery
9:30-10:00	COFFEE BREAK / EXHIBITS - Multiple Areas		
10:00-10:30	<b>CARBON COMPOSITES - PART 2: Opportunities &amp; Challenges (cont'd)</b> <b>Felix Nguyen</b> <i>Toray Composites (America), Inc.</i> Fast-Cycle CFRP Technologies for Automobile Applications	<b>ADVANCES IN THERMOPLASTIC COMPOSITES - PART 3: Polyesters</b> <b>Victor Bravo</b> <i>National Research Council Canada</i> DLFT Experiments with Cyclic Butylene Terephthalate	<b>NANOCOMPOSITES - PART 2: Graphene Nanoplatelets</b> <b>Jon Myers</b> <i>Graphene Technologies LLC</i> Enabling the Future through Bottom-Up Synthetic Bulk Graphene
10:30-11:00	<b>Koichi Akiyama</b> <i>Mitsubishi Rayon Co., Ltd.</i> Development of Preforming Process in PCM (Prepreg Compression Molding) Technology	<b>Jim Mihalich</b> <i>Cyclics Corp.</i> In-Situ Polymerization of Reinforced Thermoplastics	<b>Lawrence Drzal</b> <i>XG Sciences, Inc.</i> Graphene Nanoplatelets: A Multi-Functional Nanomaterial Additive for Polymers and Composites
11:00-11:30	<b>Changchun Zeng</b> <i>FAMU-FSU College of Engineering</i> Recycling of Carbon Fiber Reinforced Composites by Using Supercritical Water		
11:30-12:30	LUNCH - North Patio / EXHIBITS - Multiple Areas		
12:30-1:00	<b>BUSINESS TRENDS &amp; TECHNOLOGY SOLUTIONS - PART 1:</b> <b>Paul Dugsin</b> <i>Chetna Consulting</i> Shifting into High Gear: Open and Holistic Research Models as an Accelerator for Innovation in the North American Composites Industry	<b>ADVANCES IN THERMOPLASTIC COMPOSITES - PART 4: Additives &amp; Mixed-Resin Systems</b> <b>Chandrashekar Raman</b> <i>Momentive Performance Materials</i> Thermally Conductive but Electrically Insulating Plastics for Thermal Management Applications	<b>ADVANCES IN THERMOSET COMPOSITES PART 2: SMC &amp; BMC</b> <b>Cheryl Ludwig</b> <i>Chromaflo Technologies Corp.</i> The Art and Technology of Controlling Alkaline Earth Oxide Thickeners in SMC
1:00-1:30	<b>Jacqueline Stagner</b> <i>University of Windsor</i> Polymeric Composites & End-of-Life Vehicles: Recycling & Sustainability Issues	<b>Louis Martin</b> <i>Addcomp North America, Inc.</i> Overview of Maleic-Anhydride-Grafted Polyolefin Coupling Agents: Uses & Benefits	<b>Randy Lewis</b> <i>P. R. Lewis Consulting, LLC</i> BMC with Unprecedented Adhesion to Fillers, High Glass Transition Temperature and Chemical Resistance
1:30-2:00	<b>Tom Lobkovich</b> <i>General Motors Co.</i> Development & Execution of Composite-Intensive Coach for EN-V Demonstration Vehicle Fleet	<b>Uday Vaidya</b> <i>University of Alabama at Birmingham</i> Thermoplastic Sandwich Composites from Recycled Sources for Impact Damage Tolerance & Crashworthiness	
2:00-2:15	CLOSING REMARKS & SPE ACCE PART INNOVATION AWARD <b>Creig Bowland</b> , '11 & '12 SPE ACCE Chair, PPG Industries		
2:15	CONFERENCE ADJOURNS		
4:30-6:30	THURSDAY AFTERNOON: OFFSITE PLANT TOUR AT PLASAN CARBON COMPOSITES R&D CENTER IN WIXOM, MICH. (SEE CARBON COMPOSITES MOLDED VIA NEW OUT-OF-AUTOCLAVE PROCESS) MUST PREREGISTER TO ATTEND. LIMITED TO 40 PARTICIPANTS.		
8:30-5:00	ALL DAY FRIDAY: OFFSITE TOUR OF NEW FRAUNHOFER PROJECT CENTRE FOR COMPOSITES RESEARCH IN LONDON, ONTARIO. (SEE D-LFT & D-SMC MOLDING SETUPS) MUST PREREGISTER TO ATTEND. LIMITED TO 60 PARTICIPANTS.		





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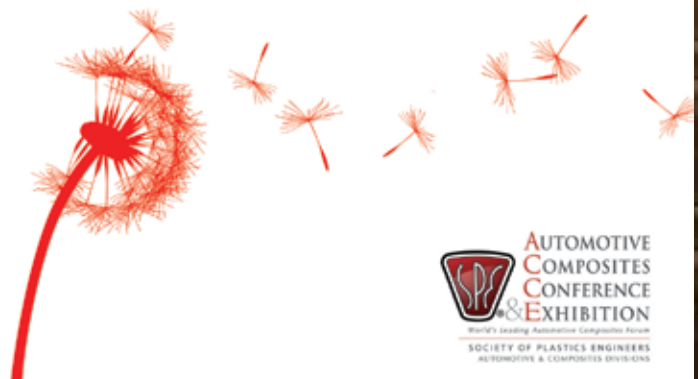


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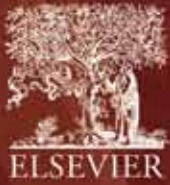
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TUESDAY MORNING:  
TECHNOLOGY READINESS 1 – PART 1:  
European Composites Innovations

Lee Harper, Nottingham University  
*Advancements in Discontinuous Carbon Fibre Composites for Automotive Applications*  
Not Available at Press Time

Jonah Jimenez, Sigmatex High Technology Fabrics  
*A Novel 3D Weaving Process for Low Cost, Complex Carbon Fiber Preforms*

Carbon fiber preforms enable the use of infusion fabrication processes for complex, structural components. This presentation covers recent advances in the use of a novel 3D weaving process to produce hollow and graded pre-forms to meet the requirements of complexity and cost in automotive applications. This 3D process has been used to produce an “A-pillar node” using a carbon fiber preform and a resin-infusion fabrication process. The process has also produced continuous carbon fiber fabric with varying wall thicknesses.

Speaker to be Announced  
Topic to be Announced  
Not Available at Press Time

Graham Barnes, Engenuity Limited  
*Beyond Crash Tubes: Extending Composite Impact Predictions to Adhesively Bonded Energy Absorption Structures*  
The author is a true believer in the potential for high-performance composites to revolutionize the safety and environmental impact of mainstream production cars. Mainstream composites are just around the corner and safety in crash is one of their biggest benefits, but until recently the hardest to predict.

TUESDAY MORNING:  
COMPOSITES TUTORIAL – PART 1:  
Introduction to Polymer Composites

Presented by the Automotive Composites Alliance & SPE Composites Division board members  
Polymer composites are the key for lightweight construction and enable automakers to reduce fuel consumption and fulfill governmental requirements. Today, processes and materials are available to produce polymer composites with an excellent cost/performance ratio.  
The tutorial will focus on materials and processes typically used for automotive part production.

TUESDAY MORNING:  
VIRTUAL PROTOTYPING & TESTING  
OF COMPOSITES – PART 1:  
Best Practices & Fiber Orientation

Mike Wyzgoski, American Chemistry Council  
*Long Fiber Reinforced Thermoplastics Predictive Engineering Activities*

Since 2006, Oak Ridge National Laboratory (ORNL) and Pacific Northwest National Laboratory (PNNL) have conducted research in Predictive Engineering (PE) of injection-molded, long-glass fiber (LGF) thermoplastic parts, funded by the U.S. Department of Energy. During this time, the American Chemistry Council’s (ACC’s) Plastics Division - Automotive Team has worked to identify and fund necessary critical research, collaborating with the national labs to validate modeling data. The result: a new process model to predict both fiber-orientation distribution and fiber-length distribution is now available along with mechanical property predictive tools. Now for the first time, engineers can reliably predict process modeling and design new, stronger structural components with plastics. Current ACC funded research on LGF at various universities and ORNL will also be described, setting the stage for future similar research to model injection-molded carbon fiber processes.

Dan Williams, Granta Design Ltd.  
*A Structure & Best Practice for the Management of Composites Data in Engineering Design & Materials Selection*

This talk presents the results of a 10-year collaboration with aerospace to define a formal structure for managing composites test and design data, and discusses its application in the automotive industry. The life cycle of composites data (from materials lab to product design) will be investigated, as well as approaches to evaluate cost-benefit tradeoffs of these new materials against more traditional options.

John T. Hofmann, Virginia Polytechnic Institute & State University  
\*\*\*2012 SPE ACCE Scholarship Award Winner\*\*\*  
*The Effect of Glass Fiber Length on Orientation Distribution within Center & End Gated Injection Molded Composites*

The Method of Ellipses has been applied to both short- and long-fiber polymer composites in order to evaluate the effect of fiber length on experimental orientation distribution. The resulting fiber-orientation distributions for both short- and long fiber-reinforced composites have subsequently been compared at multiple percentages of mold fill for the same geometry, including near the entry region of the mold. Preliminary data suggest that an increase from short (<1 mm) to long (>1 mm) fibers results in increased transverse fiber alignment in both the center-gated disc and along the center-line of the end-gated plaque. Furthermore, preliminary results from the end-gated geometry will be compared to data obtained from the center-gated disc in order to evaluate the effect of the more complex, 3-dimensional flow field found within the end-gated system.





**Cong Zhang, The Ohio State University**  
***Discontinuous Long-Fiber Reinforced Composite Processing & Final Part Stiffness Predictions***

This work employs the rod chain model of Wang et al. (2006) to study the motion of discrete flexible fibers within a polymer suspension. Model results are presented for both individual fibers and a distribution of fibers to study variations in the transient effects due to shearing flow between rigid and flexible fiber systems. The presented results demonstrate that the observed fiber motion period decreases as the fiber flexure increases, and the results provide insight into the modifications required for the equation of motion of the orientation distribution function for flexible suspensions as well as current limitations from existing short-fiber theories. A methodology for predicting the material properties of a discontinuous long wavy fiber-reinforced composite is presented using the micro-mechanical approach of Hsiao and Daniel (1996) for the underlying unidirectional stiffness tensor predictions, along with an adapted version of the rigid fiber micromechanical approach discussed by Jack and Smith (2008) for an orientationally varying distribution of fibers. The influence of the fiber waviness on the processed composite properties is shown from the simulation results, as well a discussion on possible limits of the relative fiber stiffness for industrial purposes.

**Kevin Meyer, Virginia Polytechnic Institute & State University**  
***Recent Advancements in the Simulation of Injection Molding Glass Fiber Composites***

We present long glass fiber orientation predictions in center-gated disks and end-gated plaques using both a rigid and semi-flexible fiber model and compare results to experimentally obtained orientation data. The phenomenological parameters for simulation are determined through an independent rheological testing method.

**TUESDAY: KEYNOTE 1**  
**Sebastian Schelper, BMW AG**  
***Affordable Composites for High Volume Production in the BMW i8***

Not Available at Press Time

**TUESDAY AFTERNOON:**  
**BIO & NATURAL FIBER COMPOSITES – PART 1:**

**Alper Kiziltas, University of Maine**  
***\*\*\*2012 SPE ACCE Scholarship Award Winner\*\*\****  
***Natural Fiber Blends-Filled Engineering Thermoplastic Composites for the Automobile Industry***

Engineering thermoplastic composites with varying concentrations (from 5 to 20 wt%) of natural fiber blends were prepared by injection molding and compression molding. The composites reinforced with natural fiber blends displayed enhanced tensile and flexural properties vs. neat nylon 6. Overall the addition of

20% natural fiber blends shows comparable or higher mechanical properties than the addition of 20% single-type fibers. The results indicate that use of natural fiber blends can help achieve the optimal physical and mechanical properties for particular applications in the automobile industry.

**Mehdi Tajvidi, University of Waterloo**  
***Viscoelastic Properties of Wheat Straw Fiber / Talc / Polypropylene Composites for Automotive Applications***

The temperature-dependent mechanical performance of composites made of isotactic polypropylene homopolymer and impact-modified polypropylene copolymer filled with wheat-straw fiber and talc are evaluated and the effects of fiber loading, matrix type, filler type, and hybridization (combination of straw and talc) were studied using dynamic mechanical thermal analysis (DMTA). The modulus retention term (MRT) and the relative storage modulus (RSM) were used as parameters defining mechanical performance at various temperatures. The short-term creep behavior of selected composites at various stress levels will also be presented.

**Alper Kiziltas, University of Maine**  
***\*\*\*2012 SPE ACCE Scholarship Award Winner\*\*\****  
***Utilization of Carpet Waste as a Matrix in Natural Filler-Filled Engineering Thermoplastic Composites for Automotive Applications***

It is possible to produce composites of microcrystalline cellulose (MCC) in high-melting engineering thermoplastics like nylon 6/6 via melt compounding followed by injection molding without compatibilizers and other additives. Tensile strength, flexural modulus, and creep resistance are improved, and thermal expansion is decreased with increasing MCC content across all temperatures, especially those in the range seen by underhood parts.

**Jeffrey J. Cernohous, Interfacial Solutions, LLC**  
***Alternative Natural Fiber Based Automotive Composites***

Wood-composite-based products (WPCs) have rapidly penetrated non-structural wood applications because they offer the consumer low maintenance attributes and durability. However, the best wood composites on the market today are half the strength, twice the weight, and as much as five times the cost of pine and cedar. Additionally, these materials lack the ductility required to displace conventional plastics and composites utilized in the automotive industry. There is a need for cost-effective natural fiber composites that have improved mechanical properties. This work describes new composite materials that are based on alternative natural fibers and feedstocks that have been recently developed to address this issue.



TUESDAY AFTERNOON:  
ADVANCES IN THERMOSET COMPOSITES –  
PART 1: Epoxy & Polyurethane

Roman Hillermeier, Momentive Specialty Chemicals GmbH  
**Advanced Thermosetting Resin Matrix Technology for  
Next Generation High Volume Manufacture of Automotive  
Composite Structures**

A new generation of epoxy resin systems has been developed that allows the rapid and economical processing of structural composites. The new thermoset formulations are unique in that they provide a long injection window for a robust impregnation of the reinforcing fiber while still enabling an extremely short cure cycle.

Tom McKay, BASF Corp.  
**Lightweight Composites: Epoxy-Matrix Materials for  
Faster RTM Processes**

Epoxy systems have mainly been restricted to parts and programs with low volumes due to relatively long infusion and cure times. Solutions exist today that have dramatically reduced cycle times, making these resins a viable solution for medium- and even high-volume parts. Information on such a system will be presented, with a review of processing challenges, solutions, and part performance.

Stephen Misencik, SAERTEX USA, LLC  
**All-Composite Transit Bus Body**

In an effort for transit bus operators in the private marketplace to achieve their goals of significantly reducing vehicle weight, lowering operating and maintenance costs, reducing carbon emissions, and realizing a longer service life, an all-composite (monocoque) transit bus body was developed. This presentation will highlight the significance of understanding thermoset resins. Chemistry and process parameters used in the design of the composite bus body will be discussed. Two different resin systems will be reviewed with regards to optimum use in development of the composite bus body shell.

Stefan Kreiling, Henkel Corp.  
**Polyurethane Matrix Resin Technology: Highly Durable  
Composites via Cost-Efficient Resin Transfer Molding  
(RTM) Processes**

A novel polyurethane matrix resin enables fast and cost-efficient composite manufacturing processes. Due to its inherent fracture toughness properties, this polyurethane technology can offer superior fatigue resistance and damage tolerance compared to standard resin systems. The presentation outlines key processing and performance characteristics for this material.

TUESDAY AFTERNOON:  
VIRTUAL PROTOTYPING & TESTING OF  
COMPOSITES - PART 2: Laminate Behavior  
& Material Models

Ali Al-Sharif, Wayne State University  
**The Effect of Low Cycle Compression Fatigue on Composite  
Sandwich Beams in the Presence of Delamination**

The effect of fatigue behavior on local delamination caused by low-velocity impact was investigated by using composite sandwich beams. The compression static tests were conducted for impacted and non-impacted samples, and compression-compression fatigue tests were carried out for specimens with impact delamination between the core and the face sheet. This study shows that compression static strength was significantly reduced by impact-induced delamination in the sandwich composite specimens, and that delamination growth did not occur for in-plane stress levels below 50% of ultimate stress of the impacted composites for this class of sandwich composites.

Russell Mailen, Baylor University  
**Laminate Stiffness & Curvature for Laminated Carbon Fiber  
Composites, Experimental Observation & Model Validation**

Carbon fiber laminates are extensively used within the automotive and aerospace industries due to their high strength to weight ratios, although their design and fabrication pose increased engineering difficulties. During manufacturing, residual strains are introduced due to a combination of curing kinetics of the thermoset resin and induced thermal strains due to a coefficient of thermal expansion (CTE) mismatch between resin and fiber. The present work presents results for a cross-ply (un-balanced) laminate. Micromechanical theories were used to predict stiffness and CTE values of an individual lamina from the constitutive properties for the fiber and the matrix. Lamina results were coupled with a finite-element structural and thermal-structural analysis and used to predict the observed stiffness and the observed strain of a processed laminate. The finite element results were then compared with the measured results and suggestions are provided for improvements on the method for future modeling and experimental studies.

Pedro Cortes, Youngstown State University  
**The Fracture Properties of a Fiber Metal Laminate Based on  
Self-Reinforced Thermoplastic Material**

The present work investigates the mechanical properties of Fiber-Metal Laminates (FMLs) based on self-reinforced composite materials. Initial results have shown that these thermoplastic multilayered structures represent a promising hybrid system for the transportation sector. It has been shown that their impact and interfacial fracture properties are considerably superior to those shown by FMLs based on thermoset materials.

Umesh Gandhi, Toyota Motor Co.  
**Study Effect of Unidirectional Tape on Fiber Reinforced  
Polymers & Development of Predictive Material Model**

Effects of unidirectional (UD) tape on injection over-molded plaques for strength and stiffness is evaluated. Also, a method to develop a unified, nonlinear, predictive material model to account for both UD tape and injection-molded material is explained.





## TUESDAY: KEYNOTE 2

Oliver Kuttner, Edison2

### **Correct Primary Decisions Leading to Positive Feedback Loops**

Not Available at Press Time

## WEDNESDAY MORNING:

### ENABLING TECHNOLOGIES – PART 1:

#### RTM & Sandwich Panel Enhancements

Raman Chaudhari, Fraunhofer-Institut für Chemische Technologie

### **Characterization of High-Performance Composites Manufactured by Using High Pressure RTM Process Variants**

The current work addresses new variants of the RTM process, namely high-pressure injection resin-transfer molding (HP IRTM) and high-pressure compression resin-transfer molding (HP CRTM) for the manufacturing of continuous-fiber-reinforced composites with high fiber-volume content. Influence of different process variables such as mold gap and resin injection time on the quality of the laminates and the mechanical properties is also analyzed.

Lolei Karine Khoun, National Research Council Canada

### **Effect of Process Variables on the Performance of Glass Fibre Reinforced Composites made by High Pressure Resin Transfer Moulding**

High-throughput and cost-effective composite manufacturing processes are essential for high-performance fiber-reinforced polymer composites to penetrate the automotive market to their full potential. High-pressure resin-transfer molding (HP-RTM) is a new process combining the manufacturing of high-performance composite parts with short cure cycles, and hence is of great interest for automotive applications. In this study, the effect of HP-RTM process parameters on the mechanical performance and quality of composite plates was investigated and optimum parameters were suggested.

Jan Kuppinger, Fraunhofer-Institut für Chemische Technologie

### **Polyurethane Base Sandwich Structures – Face Sheet Characteristics and Part Development**

The presentation addresses polyurethane-based sandwich structures manufactured with a polyurethane fiber-spraying process. The influences of different glass fiber mats in the face sheet thickness were investigated and characterization of the face sheet's thickness was carried out using X-ray computed tomography and 3D-image analysis methods for non-destructive measurements of prepared samples. Based on these results, mechanical properties of the face sheets were determined. Finally, a simplified FEM model could be applied and provided excellent agreement with the experimental data. The transfer of these results into an industrial application will be presented.

## WEDNESDAY MORNING:

### PREFORMING TECHNOLOGIES – PART 1:

Dan Buckley, American GFM

### **Preforming can be Fast and Easy**

This presentation will provide information on how to preform engineering fabrics to near-net shape and get net shape using 3D trimming. Emphasis will be on high-volume preforming with discussion of reinforcing materials, design, volume, and cost considerations. Conformability issues with mats and engineering fabrics will be discussed with pictures that demonstrate the conformability issues using structural engineering fabrics and other materials. Selective curing, energetic stitching, sub-assembly preforms, true net-shape preforms, and the inclusion of inserts and core materials will be explained with applications and pictures.

Christoph Greb, Institut für Textiltechnik of RWTH Aachen University

\*\*\*2012 SPE ACCE Best Paper Award Winner\*\*\*

### **Economic Potential of Single- & Multi-Step Preforming for Large-Scale Production of Automotive Composite Structures**

The economic potential of single-step and multi-step preforming processes was evaluated. Three different process chains for an automotive composite structure were designed and evaluated regarding cycle times and costs per unit. The validation was carried out successfully using a modified multi-axial weft insertion machine and the ITA-Preformcenter. In the described case study, costs per piece could be reduced by 11% and cycle time was decreased by 77% vs. conventional processing of standard reinforcement textiles.

Matthias Graf, Dieffenbacher GmbH

### **Advancements in the Fully Automated Preform Process for Complex Parts**

A key for low-cost, large-scale production of carbon fiber-reinforced plastic (CFRP) parts is a process-reliable, fully automated preform technology that fulfills the needs of industry. Just such a device has been developed for the mass production of dry carbon fiber preforms. The focus was on technologies to achieve a fully automated process with high repeatability. The presentation will introduce the concept of the preform center and the rationale for the technology approach taken. Various results that have been achieved together with automobile customers and the advancements that have been made towards higher productivity and material waste reduction will also be discussed.



## WEDNESDAY MORNING: VIRTUAL PROTOTYPING & TESTING OF COMPOSITES – PART 2: Modeling, Simulation & Validation

### **Suof Omran Abdalislam, Wayne State University** ***Modeling Impact Behavior of Sandwich Composite with Balsa Core***

This work presents an experimental and numerical investigation of damage analysis of sandwich composite plates comprising E-glass/epoxy composite laminate face sheets and end-gain balsa wood cores under low-velocity impact. The impact test was conducted using a drop-weight impact tower to evaluate the impact response of the sandwich structure. The primary damage modes observed were fiber fractures at upper skin, and delamination between adjacent glass-epoxy layer and core at both faces. After initial visual inspection of the top and bottom face-sheets, damage mechanisms at the interior layers and cores were ascertained through destructive analysis, i.e. sectioning of samples. Impact simulation was done using LS-DYNA® software in terms of load-deflection response. Results of finite-element modeling were compared with experimental data and good agreement was obtained.

### **Vasant Pednekar, LANXESS Corp.** ***Simulating Structural Composite Hybrid Parts Made from Continuous Fiber Reinforced Plastics***

Composites have become one of the fastest growing industries in the world by increasingly replacing metals. To utilize the full potential of hybrid composite parts for structural applications, it is imperative to be able to accurately simulate not only the mechanical behavior of the part during loading, but also forming of composite sheet becomes equally important to determine orientation of glass fiber. A new method to simulate the material model for composite sheets has been developed and implemented into a HiAnt® simulation code. This presentation provides further information about the simulation technique and the correlation with tested parts.

### **Rani Richardson, Dassault Systèmes & Jason Curtis, Inceptra LLC** ***Automotive Innovation Takes Flight – Literally***

There are only a few events that have single-handedly enabled a giant leap forward in automotive innovation, and the mass adoption of composites is one of them. The barriers to using composites on a large scale are being lowered every day and, as a result, things that were once dreams – like flying cars – are becoming a reality. This presentation describes how composites played a critical role in helping Terrafugia design, develop, and begin selling the first practical, street-legal aircraft. The Transition® Roadable Aircraft is automotive innovation defined – it can cruise up to 450 miles at 115+ mph in the air, take off and land at local airports, drive at highway speeds on any road with fuel economy upwards of 30 miles per gallon, and fit in a normal suburban garage space with wings that fold as easily as the top on a convertible.

## WEDNESDAY MORNING: ENABLING TECHNOLOGIES – PART 2: Injection Molding & Fastening Developments

### **Joe Gobernatz, ATF Inc.** ***New Lightweight Fastening Solution for Thermoplastic Composites Applications***

In the push for lightweight materials for today's vehicles, a new screw has been developed especially for plastic and composite applications. Using an aluminum alloy (7075) from the aviation industry and the innovative thread geometry of the DELTA PT screw, the new fastener, DELTA PT ALU is a viable alternative to common steel screws while lowering fastener weight by 2/3 and helping achieve a better/safer fastening joint.

### **Joachim Kragl, Engel Machinery, Inc.** ***Organomelt & In-Situ Polymerization Provide New Opportunities for Injection Molding of Composite Structures***

The presentation describes the organomelt process, which combines the molding-cell integrated forming of continuous-fiber-reinforced sheets or plaques with the injection-molding process. The process allows the high-volume production of composite parts in a very cost-effective way with a faster cycle time than with other composite manufacturing methods. Parts can be trimmed directly at the machine after the molding process to leave the manufacturing cell as a net shape, ready to be assembled.

### **Scott Powers, Trexel Inc.** ***Foam Injection Molding: Unique Process Solutions for Light Weighting Automotive Plastic Parts***

This presentation will provide insight about the latest developments in foaming plastic components to provide lower part weight for decreased fuel consumption, reduced production costs, and increased design freedom. The basis of physical and chemical foaming technologies will be discussed as well as design guidelines for maximizing weight-reduction strategies. Also reviewed will be unique applications such as microcellular foaming in combination with core back or reverse coining – which results in greater than 30% weight savings while increasing stiffness exponentially – foaming in blow molding applications, as well as the combination of microcellular foaming and hot/cold molding to attain Class A surface finishes. Last, the latest examples of successfully implemented microcellular-molded plastic parts by global automotive OEMs as well as implementation strategies will be reviewed.





### WEDNESDAY MORNING: PREFORMING TECHNOLOGIES – PART 2:

#### Ulrich Mörschel, Textechno Herbert Stein GmbH & Co. KG *Characterization of the Drapability of Reinforcement Fabrics by Means of an Automated Tester*

The behavior of standard and non-crimp fabrics in forming and draping is of importance in any production process of non-flat, fabric-reinforced composite parts. A new automatic drapeability tester allows one to automatically characterize drapeability and the formation of defects during draping and forming. The tester combines the measurement of the force, which is required for forming, with an optical analysis of small-scale defects, such as gaps and loops by means of image analysis. An optional triangulation sensor can determine large-scale defects such as wrinkles.

#### Nathan Nanlin Han, 3D Nanocomposites Inc. *Low Cost Hook & Loop 3D Composites Enable Automatic Laying-Up Fabrics for Mass Production Preforming*

Now that fast-curing resin systems have been developed, the slow hand-layup fabric process is the last major barrier for applying composites in mass production to make vehicle chassis. New hook-and-loop 3D fabrics provide a breakthrough to enable automatic preforming. With these materials, a vehicle chassis could be made automatically within 3 minutes by the resin-transfer molding process.

#### Tommy Fristedt, LayStitch LLC *Novel Fiber Placement Technologies for Composite Applications*

Recent development in design tools and machine technology allows automated tailored-fiber placement (TFP) to be used to improve fiber-reinforced composites. By laying out fiber tow/roving selectively and only where needed, preform material costs may be reduced considerably vs. using woven or knitted multi-axial materials. Various application examples and design techniques will be presented along with their resulting benefits when used in simple as well as fairly complex preforms.

### WEDNESDAY MORNING: VIRTUAL PROTOTYPING & TESTING OF COMPOSITES – PART 3: Modeling, Simulation & Validation (cont'd)

#### Sejin Han, AutoDesk *The Numerical Analysis & Validation of Compression Molding Process*

In this work, simulation results from a program developed for the three-dimensional analysis of compression molding of thermoset composites were compared to experimental results of an actual molded thermoset sample. The program predicts flow pattern, fiber orientation, fiber length distribution, curing of the resin, and mechanical properties. Comparison between simulation and exper-

iment includes short shots and fiber orientation. Actual fiber orientation images were obtained using CT scanning. The comparison shows reasonable agreement between simulation and experiment.

#### Roger Assaker, e-Xstream engineering *\*\*\*2012 SPE ACCE Best Paper Award Winner\*\*\* Stiffness, Failure & Fatigue of Fiber Reinforced Plastics*

The presentation provides an overview of recent micromechanical approaches to predict stiffness, failure, and fatigue for short-, long-, and continuous-fiber reinforced polymer composites more accurately. Each type of composite provides its own challenge and needs individual treatment to predict performance. This is made all the more complex owing to the influence of reinforcements on composites as it causes anisotropic and locally different material behavior depending on processing conditions, strain rates, temperature, static or dynamic loading, and other end-use conditions. The goal is to provide material models in an efficient manner so they can be used in an industrial simulation environment.

#### Richard Schaake, SKF Engineering & Research Centre *Estimation of Anisotropic Stiffening Feature Properties in Early Design Phase*

To evaluate the performance of a design, the properties of thermoplastic composites need to be known. Datasheet properties may not be available for the relevant conditions and for new polymer/fiber combinations the available data may not be of sufficient quality to allow a good estimate of the performance that may be expected. We demonstrate a method to derive the matrix properties of a thermoplastic composite from a shear compliance master-curve to estimate the performance of both short and continuous fiber composite parts that have been geometrically stiffened.

### WEDNESDAY: KEYNOTE 3

#### Gary Lownsdale, Plasman Carbon Composites & Calvin Bamford, Globe Machine Manufacturing Co. *Cutting Cycle Time for Prepregged Carbon Fiber Composites*

New out-of-autoclave technology that has been developed for prepregged carbon fiber composites reduces cycle time by 75% vs. autoclave processing. The technology permits Plasman Carbon Composites to achieve a balanced 17 minute part-to-part cycle time. The new process is applicable to Class A and structural parts, producing better part surface quality than autoclave processing. Additionally, fewer consumables and significantly less energy are expended. Development of this new technology – from concept to production-representative in 12 months – will be presented.



### WEDNESDAY AFTERNOON: ENABLING TECHNOLOGIES – PART 3: Combining Discontinuous & Continuous Reinforcements

#### Manfred Reif, Fraunhofer-Institut für Chemische Technologie *Multi-Material Design – Lightweight Design for Electric Vehicles*

The simple substitution of materials is not sufficient to meet the demands placed on components. Instead, it is necessary to combine the advantages of different materials and to tailor them for component-specific requirements. Multi-material design is the key to developing resource-efficient and (modular) lightweight solutions, especially for electric vehicles. In order to develop material combinations for structural applications, a feasibility study on the multi-material design of a battery tray for an electric vehicle was carried out in the funded project "Systemforschung Elektromobilität (System Research into Electromobility)."

#### Jan-Anders Månson, EELCEE AB *QEE-TECH™ - Thermoplastic Composites for High Volume Structural Applications*

QEE-TECH™ is an integrated processing technique that enables the production of structural, lightweight thermoplastic composite parts in high series. The tailored preforms allow a "shorter and faster" path from fiber and polymer via preforms to finished parts vs. most other composite-forming techniques. The technology enables step changes in both design and performance as well as the freedom to place fibers according to the load requirements, which gives maximal use of the more expensive composite. Furthermore, the possibility of "looping" the preform tow around mounting points provides an excellent load introduction and load transfer to adjacent elements. Complex-shaped parts with high functional integration with tailored structural properties can be manufactured. The technology integrates the advantages of conventional molding along with those of continuous-fiber reinforcements and can be implemented with traditional injection or compression molding production units with limited additional investments.

#### Benjamin Hangs, Fraunhofer-Institut für Chemische Technologie *\*\*\*2010 SPE ACCE Scholarship Award Winner\*\*\**

#### *Co-Compression Molding of Tailored Continuous-Fiber Inserts and Inline-Compounded Long-Fiber-Thermoplastics*

Thermoplastic parts made from discontinuous-fiber materials like direct long-fiber thermoplastic (D-LFT) are well established in the industry for non- or semi-structural applications. Adding continuous-fiber reinforcements can lead to innovations that help realize the high potential of structural thermoplastic composite applications. Due to the limited drapeability and flowability of such continuous-fiber-reinforced (CFR) materials, however, the forming of highly complex structures such as ribs is not feasible. One way to overcome this barrier in design freedom of parts incorporating CFR sections is the combination of those process technologies for continuous- and discontinuous fiber-reinforced materials. In the presented case study, an

extensive investigation was performed to identify challenges that must be considered for co-compression molding of tailored inserts made from unidirectional tape (UD tape) with directly compounded long-fiber-reinforced thermoplastics (D-LFT). This presentation first covers a flow study based on a plaque tool and, secondly, transfer of results to realize a full-scale underbody-shield demonstrator.

### WEDNESDAY AFTERNOON: ADVANCES IN THERMOPLASTIC COMPOSITES – PART 1: Polyamides

#### Manoranjan Prusty, BASF SE *New PA with Advanced Stabilization & Higher Glass Loading Improves Mechanicals at Elevated Temperatures*

A new high-heat polyamide with advanced stabilization and higher glass loadings offers new opportunities for thermoplastic composites to be used in the challenging underhood environment. The new materials are characterized by outstanding heat aging, long-term service temperature performance, good processability, and excellent weldline strength. The products are ideal for use on all parts in the charge-air duct, including intercooler end caps, resonator, charge air lines and throttle valves, or intake manifolds with water-cooled intercoolers, offering automakers new opportunities to replace metal in key underhood application.

#### Jonathan Spiegel, Polystrand *Development of Continuous Fiber Reinforced Nylon Composites for Structural Applications*

While the use of thermoplastics, both unfilled and as-reinforced composites, is now common automotive practice, applications of these materials has generally been limited to components that experience low to moderate structural loads. While development of long-fiber-reinforced thermoplastic (LFRT) nylon technology has yielded improved properties and allowed higher load profiles, the development of CFRT (continuous-fiber-reinforced thermoplastic) nylon composites will now allow us to approach applications previously only possible with either metal or thermoset composite construction.

### WEDNESDAY AFTERNOON: ADVANCES IN COMPOSITE REINFORCEMENT TECHNOLOGIES – PART 1: New Options for Improving Mechanicals

#### Andy Rich, Element 6 Consulting *The Effect of Changing Process, Resin, & Fiber Architecture on Composite Properties*

Generally, when predicting the properties of composites, the Rule of Mixtures is the standard tool used for most applications. However, for certain combinations of materials, and certain mechanical property tests, it has been discovered that this rule does not work. When testing a wide variety of composite materials in a comprehensive battery of tests, several examples of wide discrepancies were found between predicted values and actual test data.





Juan Serrano, PPG Industries

***Technological Developments in Fiber Glass Composites for Lightweight Structural Application Solutions***

This presentation will focus on recent advancements in high-performance fiberglass reinforcements that are specifically designed for weight savings along with processing and fabrication flexibility for targeted structural auto parts. New developments in thermoplastic and thermoset technologies, combined with new fiber solutions, will be reviewed.

Andrew Head, A&P Technology

***Braided Reinforcements Enable Nimble Automation of Composite Molding***

The braiding process is an inherently automated way to create specific fiber architectures and geometries. This type of manufacturing is ideal for designers interested in a reduced layup time and a process that is repeatable. Manufacture of near-net-shape preforms can be achieved through the following braided solutions: braided sleeves conforming to complex part geometries; overbraiding; the use of braided fabrics, specifically fabrics with a quasi-isotropic (0°, ±60° degree) and an off-the-shelf ±45° orientation; and in combination with composite processes developed by industry partners. Braiding of net-shape preforms offers the same architectural features as those found in the hand layup process, while providing the economic efficiencies found with automated processes. This results in the creation of parts optimized for strength and stiffness with better impact resistance, damage tolerance, and fatigue properties.

WEDNESDAY: KEYNOTE 4

Nathan Armstrong, Motive Industries

***Composites in Space***

Not Available at Press Time

WEDNESDAY: KEYNOTE 5

Jan-Anders Månson, Ecole Polytechnique Federale De Lausanne (EPFL)

***Opportunities & Challenges for Automotive Composites***

By the potential of new manufacturing and material forms, composites in automotive have gone from being an exotic alternative to a more realistic option in high-volume applications. The last years have seen development of a large number of new technologies, all with great potential. However, there are still challenges ahead before an extensive replacement of the metallic mainstay is realistic in large-scale production. The challenges for composites go beyond mechanical performance and cost level: they also have to prove a competitive advantage in terms of environmental performance. In order to capitalize on their benefits, targeted improvement strategies must be employed that are guided by a sound understanding of environmental performance. It will be essential to provide guidance for product development; however, specific models need to be developed to assess key life cycle phases for composite materials. Such models will assist in optimizing production technology and application design. This will result in increased understanding of the merits and limitations of composites and provide clearer recommendations for suitable applications and production volumes.

THURSDAY MORNING:

**CARBON COMPOSITES – PART 1:**

**Opportunities & Challenges**

Cliff Eberle, Oak Ridge National Laboratory

***Status of Low-Cost Carbon Fiber Developments***

Technologies to drive down the cost of industrial-grade carbon fibers are needed to enable the widespread application of carbon composites in automobiles to reduce vehicle weight and fuel demand. Strategies for the development and deployment of low-cost carbon fibers include lower cost raw materials; high-rate, energy efficient processing; advanced post-treatment; and prototyping at such semi-production scale. Such strategies are being pursued in technology development at Oak Ridge National Laboratory and other research institutions. This presentation provides an overview of technology development pathways and the current status of each approach.

George Husman, Zoltek Companies, Inc.

***Carbon Fiber Composites – Low Cost Materials and Manufacturing Options***

The need for lightweighting of automotive structures has spurred tremendous interest in, and development of, carbon fiber composite materials and manufacturing. This presentation will first focus on the status of the carbon fiber industry and its ability to meet demands for the automotive market. A specific update will be presented on the development and commercialization of new low-cost carbon fiber based on lignin/PAN precursor technology. Then the presentation will discuss carbon fiber composite manufacturing processes, including carbon SMC, RTM, wet pressing, and thermoplastic processes. Current projects, molding demonstrations, performance data, and cost modeling also will be discussed.

Glade Gunther, UMECO

***Dform: Enabling the Use of High Performance Materials in High Volume Applications***

DForm demonstrates cost reduction, rapid throughput, and high performance in a single material format, allowing the use of prepreg carbon fiber in mid- to high-volume automotive applications by combining novel technologies with automation and preforming. Design-specific customization of material formats maximizes material performance and utilization while minimizing labor and consumables, and allows for the use of a variety of high-performance fibers and resins, and truly optimized structural design. This presentation will demonstrate the ongoing development of automation, cost reduction, rapid throughput, as well as maturing recycling technologies that can be incorporated in the overall process.



THURSDAY MORNING:  
ADVANCES IN THERMOPLASTIC COMPOSITES  
– PART 2: Polyolefins

Kunal Kumar, Hanwha Azdel, Inc.

**Development of a New Light Weight Reinforced Thermoplastic for Automotive Interiors**

Automotive customers are demanding substrates that are lighter weight and lower cost for interior applications. In addition, there are the technical challenges of achieving the same or higher acoustical and mechanical performance. This presentation briefly discusses a unique product that achieves these goals and reviews the acoustical and mechanical performance of this new composite in comparison to the original composite.

Duane Emerson, Ticona Engineering Polymers

**\*\*\*2012 SPE ACCE Best Paper Award Winner\*\*\***

**Using Unidirectional Glass Tapes to Improve Impact Performance of Thermoplastic Composites in Automotive Applications**

The presentation describes a study conducted by organizations in Europe and North America that looked at methods to increase stiffness/strength and impact resistance of thermoplastic composites by using continuous-strand, unidirectional-glass (UD) tapes to produce woven fabrics as well as tailored blank laminates. Combinations of the tape fabrics and the tape laminates in various layup patterns were then used in conjunction with charges produced in the direct-long-fiber thermoplastic (D-LFT) inline compounding (ILC) process to compression mold both test plaques and later an actual automotive underbody-shield part to determine the extent to which impact performance was improved and to ensure cycle times were consistent with automotive production requirements.

Jim Keeler, Albis Plastics Corp.

**Higher Temperature PP-Based Composite Provides Nylon/PA-Level Performance at Lower Weight & Cost**

With light vehicles becoming a highly preferred consumer product globally, governments have been addressing energy consumption and environmental impacts with increasingly stringent regulations. New plastic materials are an essential part of the solution path allowing automotive engineers to replace metal or higher cost plastics, *lightweight* parts through increased strength for lower total part cost, and switch to lower density material solutions. A new polypropylene-based compound offering nylon-like properties at lower total cost and weight has been developed. Properties of this new material will be compared to traditional automotive materials, including mechanical and thermal properties as well as hot oil and oven aging. Target applications that would benefit from this performance profile will be mentioned.

THURSDAY MORNING:  
NANOCOMPOSITES – PART 1:  
Nanotubes & Nanofibers

Carla Leer Lake, Applied Sciences Inc.

**Carbon Nanofiber Composites: From Innovative R&D to Commercial Reality**

Structural applications that require high strength-to-weight and stiffness-to-weight ratios introduce opportunities for advanced thermoplastic composites. Nanoparticle additives have been of particular interest in efforts to improve composite performance or to impart new composite properties, such as electrical conductivity into fiberglass composites. Composites reinforced with carbon nanomaterials have high potential to enable advances in material performance as well as manufacturing simplification and cost reduction.

David Inglefield, Virginia Polytechnic Institute & State University

**\*\*\*2011 SPE ACCE Scholarship Award Winner\*\*\***

**Functionalization of Multi-Walled Carbon Nanotubes with Hydrogen Bonding Sites for High Performance Polyurethane Nanocomposites**

Hydrogen bonding functionalities were introduced onto the surface of multi-walled carbon nanotubes (MWCNTs) using acid oxidation to promote intermolecular interactions and facilitate dispersion in polyurethane matrices. Chemical oxidation was achieved by refluxing with concentrated nitric acid, which introduced carboxylic acid groups onto the MWCNT surface. These surface-bound reactive carboxylic acid groups were further functionalized into amide-amine and amide-urea derivatives, providing an opportunity for additional hydrogen bonding on the surface of the MWCNT. Functionalized MWCNTs were dispersed in a 45 wt% hard-segment polyurethane matrix with sonication, and composite film properties were measured to investigate the influence of surface functionality on thermal and mechanical properties.

David Lashmore, Nanocomp Technologies

**All CNT Lithium Based Secondary Battery**

A silicon-coated carbon nanotubes (CNT) anode has demonstrated 100 charge/discharge cycles in a lithium-based anode chemistry at twice the capacity of a graphite electrode. The replacement of an aluminum cathode with CNT material allows the use of corrosive electrolytes in the electrolyte, thus improving power performance because the galvanic Al/Cu couple is removed from the system. The use of strong CNT electrodes enables the elimination of conductive binders, conductive additives, and dramatically lowers cell resistance, therefore lowers Joule heating. Together, these advantages using sulfur-based chemistry are expected to yield much high-specific capacity, specific energy, and better thermal stability than existing technologies. For the first time, the increase in capacity enables the mass production of this new kind of approach to secondary batteries. A CNT-polymeric composites is suggested to replace the standard steel case to improve damage protection and reduce weight.





THURSDAY MORNING:  
CARBON COMPOSITES – PART 2:  
Opportunities & Challenges

**Felix Nguyen, Toray Composites (America), Inc.**  
***Fast-Cycle CFRP Technologies for Automotive Applications***

In response to the high demands of automotive manufacturers for the production of low-cost carbon fiber-reinforced plastic (CFRP) parts for low- to mid-end automobiles, new fast-cycle manufacturing technologies for both fabrics and unidirectional fibers have been developed. A rapid-cure resin technology combined with a resin-transfer molding (RTM) process for fabrics has achieved a 10-min cycle time. Slitting technology for unidirectional prepregs, when combined with the rapid-cure resin technology and the interphase technology to maximize strength translation, could offer a competing alternative for automotive manufacturers to process unidirectional fibers in applications where use of fabrics could be a constraint.

**Koichi Akiyama, Mitsubishi Rayon Co., Ltd.**  
***Development of Preforming Process in PCM (Prepreg Compression Molding) Technology***

Recently prepreg compression molding (PCM) technology was introduced as a high-cycle carbon fiber-reinforced plastic (CFRP) molding process that is suitable for production of high-volume automotive applications. Further progress has been achieved in development of PCM technology – especially in the preforming process, which can rapidly produce near-net-shape preforms for complex shape parts produced with compression molding. The combination of high-cycle preforming and compression molding exhibits high potential to be used for high-volume automotive CFRP parts production.

**Changchun Zeng, FAMU-FSU College of Engineering**  
***Recycling of Carbon Fiber Reinforced Composites by Using Supercritical Water***

Supercritical fluid recycling has emerged as a viable method for recycling carbon fiber-reinforced plastic (CFRP), since it possesses several advantages over other recycling technologies. This work presents investigation of the recycling of CFRP and reuse of reclaimed materials using supercritical water and an aerospace-qualified composite system. Both single- and multiple-layer composites were fabricated for the study. The effects of recycling conditions on resin elimination were systematically investigated. Extremely high efficiency was achieved, with as much 99% of resin being removed from multiple-layer composites samples. The recovered fibers, which retained their original woven architecture and showed no surface damage, demonstrated excellent retention of properties. The reclaimed degradation product (RDP) was also combined with fresh resin and cured. The properties of the reclaimed-fiber composites and cured RDP/resin mixtures were measured and these revealed possible scenarios for the utilization of these materials. A preliminary investigation on the economic viability of the process was also conducted by using process simulation.

THURSDAY MORNING:  
ADVANCES IN THERMOPLASTIC COMPOSITES  
– PART 3: Polyesters

**Victor Bravo, National Research Council Canada**  
***DLFT Experiments with Cyclic Butylene Terephthalate***

Cyclic oligomers have low molecular weights and therefore exhibit very-low viscosities prior to polymerization. This characteristic is very appealing for the production of composites, as reinforcing fibres can be thoroughly wetted by the oligomer before starting the polymerization process. An exploratory project has been initiated for evaluating these oligomers in the direct-long-fiber thermoplastic (D-LFT) process. This presentation gives a description of the experiments conducted to date and the results obtained.

**Jim Mihalich, Cyclics Corp.**  
***In-Situ Polymerization of Reinforced Thermoplastics***

Most reinforced thermoplastics are produced from fully polymerized resins that are then combined with reinforcements in a compounding extruder or an extruder that coats and forms tapes of various sizes. By introducing reinforcement into resin prior to polymerization, the high viscosity of the thermoplastic resin does not inhibit full incorporation and wetting out of the reinforcement. The tradeoff becomes the polymerization step, which still must take place prior to having a serviceable composite. Four processes – reactive extrusion of nano-clay-reinforced polybutylene terephthalate (PBT); direct long-fiber compounding with compression molding; reactive extrusion coating of continuous-fiber cloths to produce high-volume-fraction sheets; and molding of continuous-fiber-reinforced parts – will be discussed.

THURSDAY MORNING:  
NANOCOMPOSITES – PART 1:  
Graphene Nanoplatelets

**Jon Myers, Graphene Technologies LLC**  
***Enabling the Future through Bottom-Up Synthetic Bulk Graphene***

A novel method has been developed for atom-by-atom synthesis of bulk graphene. This method is efficient, scalable, and produces a uniquely small aspect and few-layer material. This material may be useful in a number of automotive applications.



Lawrence Drzal, XG Sciences, Inc.

## **Graphene Nanoplatelets: A Multi-Functional Nanomaterial Additive for Polymers and Composites**

Graphene-based nanoparticles appear to have a number of desirable intrinsic properties that make them particularly attractive as additives to polymers and composites as well as for energy-storage applications. The graphene structure of carbon is largely responsible for the unprecedented high level of intrinsic mechanical, electrical, and thermal properties obtained in carbon nanotubes (CNTs). While the tubular graphene structure in the CNT is synthesized from a 'bottom-up' approach, graphene itself can be inexpensively and efficiently extracted in nanoplatelet morphology by a 'top-down' approach using common chemicals starting with mineralogical graphite with properties competitive to CNTs. Nanocomposites for electrical shielding, and energy storage, generation, and thermal management require these nanomaterials to not only be dispersed but also to be structured in 2D and 3D nanostructures in order to achieve high-performance macro devices and applications. This presentation will describe graphene nanoplatelets and the use of nanostructuring to generate 2D and 3D microstructures for graphene nanoplatelets either by themselves or with thermoset and thermoplastic matrices. Examples of such methods to create 2D and 3D nanostructured morphologies for composite structural and energy storage and generation applications will be discussed.

## THURSDAY AFTERNOON: BUSINESS TRENDS & TECHNOLOGY SOLUTIONS – PART 1:

Paul Dugsin, Chetna Consulting

## **Shifting into High Gear: Open and Holistic Research Models as an Accelerator for Innovation in the North American Composites Industry**

Know-how is a key ingredient in the creation of value and the continual development of know-how is a critical competitive advantage. How is this best achieved? Organizational R&D strategies and models need to reflect the environment to which they are designed to respond. While we still refer to the value chain, solving technology problems today is often best served through a more holistic approach that sees the market as a value ecosystem. Using the new Fraunhofer Project Centre for Composite Materials Research at Western University in London, Ontario as a context, the author will discuss how applied, collaborative, and open-platform research approaches are proving to be effective and efficient for the acceleration of innovation and technology adoption within the North American composites industry.

Jacqueline Stagner, University of Windsor

## **Polymeric Composites & End-of-Life Vehicles: Recycling & Sustainability Issues**

As the efficiency of vehicle manufacturing and operation improves, the end-of-life impacts become more significant. This paper provides an overview of the end-of-life phase for automobiles, with particular focus on the dismantling and shredding processes and the recovery of materials. It then examines composite material recovery from end-of-life vehicles and concludes that there are no simple solutions. Instead, it will likely involve a combination of targeted unit operations such as dismantling of components from vehicles and/or pretreatment prior to shredding, along with design-for-environment principles to enable the efficient recovery of materials at the end-of-life phase.

Tom Lobkovich, General Motors Co.

## **Development & Engineering of Composite-Intensive Coach for EN-V Demonstration Vehicle Fleet**

This presentation describes the design and development of coaches (bodies) for an EN-V demonstration vehicle fleet of 9 non-production vehicles (3 each of 3 models) that featured extensive use of composite materials to successfully meet the integration challenges of a unique propulsion system as well as achieve compelling, innovative aesthetic design. Carbon fiber composites were used as the primary material for interior, exterior, and structural members. These materials were selected for their combination of high stiffness, low mass, and ability to leverage low-cost, rapid-turnaround tooling. Polycarbonate was used for all glazing in order to reduce weight and achieve complex shapes. Lastly, sintered plastic parts were used for secondary reinforcements and were fabricated via additive manufacturing techniques to reduce tooling time and cost. Ultimately, the use of the composites, coupled with appropriate use of metals at high-load interfaces, provided a highly effective solution to vehicle program requirements.

## THURSDAY AFTERNOON: ADVANCES IN THERMOPLASTIC COMPOSITES – PART 4: Additives & Mixed-Resin Systems

### **Chandrashekar Raman, Momentive Performance Materials** **Thermally Conductive but Electrically Insulating Plastics for Thermal Management Applications**

Boron nitride (BN) is a synthetic ceramic material that exhibits both excellent thermal conductivity and dielectric properties. Loading BN into thermoplastic resins therefore enables unique composite materials that are thermally conductive but electrically insulating. However compounding BN powders into plastics presents various challenges and the resultant composites exhibit anisotropic behavior due to the platelet structure of BN crystals. Optimal processing methods and ways to maximize thermal conductivity of BN/plastic composites in the desired directions are reported in this presentation. Predictions from the Lewis Nielsen model with one fit parameter ("A") are compared to the thermal conductivity data, and the model is extended further to composites with multiple fillers.





Louis Martin, Addcomp North America, Inc.

**Overview of Maleic-Anhydride-Grafted Polyolefin Coupling Agents: Uses & Benefits**

Maleic-anhydride-grafted polyolefins can be used as coupling agents or compatibilizers between olefins and inorganic materials or other polymers. They provide the most cost-effective solution in many applications such as polypropylene/fiberglass coupling and inter-laminar adhesion. However, there are many misunderstandings in the industry about when their use is beneficial, and when it is unnecessary and potentially counterproductive. This presentation will provide an overview of the category of products, their qualities, current and potential future uses, and development directions.

Uday Vaidya, University of Alabama at Birmingham

**Thermoplastic Sandwich Composites from Recycled Sources for Impact Damage Tolerance & Crashworthiness**

A range of scrap materials from edge trims and power plants were converted into thermoplastic sandwich-composite constructions applicable to automotive, mass-transit, and truck applications. The core and face sheets of the sandwich panels were made from entirely recycled sources and provide value-add as a replacement for plywood and sheet metal. Crashworthiness of this material was evaluated with a series of low-velocity and high-speed blunt object impacts to explore their failure mechanisms and energy absorption behavior.

THURSDAY AFTERNOON:

**ADVANCES IN THERMOSET COMPOSITES – PART 2: SMC & BMC**

Cheryl Ludwig, Chromaflo Technologies Corp.

**The Art and Technology of Controlling Alkaline Earth Oxide Thickeners in SMC**

As SMC applications become more challenging, as regulations become more restrictive, and as customers' expectations for tighter tolerances and more consistent product increase, formulators and processors need to become more creative. To support the changing chemistries and demanding requirements in SMC compounding and molding processes, understanding of the thickening response and advanced testing capabilities allow for expanded design of appropriate thickeners to meet the industry's needs.

Randy Lewis, P.R. Lewis Consulting, LLC

**BMC with Unprecedented Adhesion to Fillers, High Glass Transition Temperature and Chemical Resistance**

A new bulk-molding compound (BMC) manufactured from a new thermoset resin and using a proprietary mixing process offers unprecedented adhesion to fillers and reinforcements that standard BMC grades cannot achieve – particularly with reinforcements like aramid fibers. Parts are currently being molded with this aramid-reinforced BMC and machined to a surface similar to glass-filled standard BMC. However, these non-standard fillers and the unique 250°C+ glass-transition temperature of the resin allow this composite to work in more demanding applications. Examples include machined wear bushings that have unprecedented use life along with extreme high temperature, chemical resistance, and variable specific gravity – properties long sought by the automotive industry.

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# 2012 SPE<sup>®</sup> ACCE Best Paper Award Winners to be Honored During Opening Ceremonies

*Three* Best Paper Award winners – two from industry and one from academia – will be honored during opening ceremonies at the 2012 SPE ACCE. These authors received the highest average ratings by conference peer reviewers out of a field over 70 contenders and will be honored for *Excellence in Technical Writing* during opening ceremonies.

This year's winners are Duane Emerson, Senior Applications Engineer – Composites Strategic Programs Group with Ticona Engineering Polymers; Christoph Greb, Deputy Head of Composites, Institut für Textiltechnik (Institute for Textile Technology) at RWTH Aachen University; and Dr. Jan Seyfarth, DIGMAT Product Manager at e-Xstream engineering.



Duane Emerson of *Ticona Engineering Polymers* will present a paper entitled *Using Unidirectional Glass Tapes to Improve Impact Performance of Thermoplastic Composites in Automotive Applications* in the Advances in Thermoplastic Composites session on September 13 from 8:30-9:00 a.m. The paper describes a study conducted by organizations in Europe

and North America last year that looked at methods to increase stiffness/strength and impact resistance of thermoplastic composites by using continuous-strand, unidirectional-glass (UD) tapes to produce woven fabrics as well as tailored blank laminates. Combinations of the tape fabrics and the tape laminates in various layup patterns were then used in conjunction with charges produced in the direct-long-fiber thermoplastic (D-LFT) inline compounding (ILC) process to compression mold both test plaques and later an actual automotive underbody-shield part to determine the extent to which impact performance could be improved and to ensure cycle times were consistent with automotive production requirements.

Emerson is a Senior Applications Engineer – Composites Strategic Programs Group with Ticona Engineering Polymers. He has been a member of Ticona's Technical Services group in Auburn Hills, Michigan, U.S.A. since 2001, focusing on new client and application development related to alternative-processing technologies, including the fabrication of thermoplastic composites. Emerson's expertise includes a wide range of metal-to-plastic conversions within the automotive industry (e.g. exterior body components and windshield-wiper systems), military hardware, and Industrial applications (e.g. fluid-handling pumps, air compressors, door hardware, power tools, and min-

ing & construction equipment). He holds a Bachelor's degree in Mechanical Engineering from the University of New Hampshire.

Christoph Greb of the *Institut für Textiltechnik (Institute for Textile Technology) at RWTH Aachen University* in Germany will present a paper entitled *Economic Potential of Single- & Multi-Step Preforming for Large-Scale Production of Automotive Composite Structure* in the Preforming Technologies session on September 12 from 9:00-9:30 a.m. The paper discusses the economic potential of single-step and multi-step preforming processes. Three different process chains for an automotive composite structure were designed and evaluated with regard to cycle times and costs per unit. Validation was carried out using a modified multi-axial weft insertion machine and the university's own ITA-Preformcenter. In the described case study, piece costs were reduced by 11% and cycle time was decreased by 77% vs. conventional processing of standard reinforcement textiles.



In 2008, Greb became a Scientific Co-Worker in the Fiber-Reinforced Composites Department at RWTH Aachen University's Institute for Textile Technology with a focus on preforming technologies for fiber-reinforced composites. In 2010, he became Head of the Research Group on 3D Preforming there, and in 2011, he became Deputy Head of Composites. Greb holds a Diploma in Mechanical Engineering from RWTH-Aachen University.





Jan Seyfarth of *e-Xstream engineering* was lead author on a paper entitled *Stiffness, Failure & Fatigue of Fiber Reinforced Plastics* that will be presented by co-author, Roger Assaker in the Virtual Prototyping & Testing of Composites session on September 13 from 8:30-9:00 a.m. The paper provides an overview of recent micromechanical approaches to predict stiffness, failure, and fatigue for short-, long-, and continuous-fiber reinforced polymer composites more accurately. Each type of composite provides its own challenge and needs individual treatment to predict performance, and this is made all the more complex owing to the influence of reinforcements on composites as it causes anisotropic and locally different material behavior depending on processing conditions, strain rates, temperature, static or dynamic loading, and other end-use conditions. The goal is to provide material models in an efficient manner so they can be used in an industrial simulation environment.

Seyfarth is DIGIMAT Product Manager at e-Xstream engineering, a position he has held since 2010. At the company, Seyfarth is responsible for coordinating the development of new software and providing sales and marketing support in Southern Germany. Before joining e-Xstream, he was Product Manager for DIGIMAT at software reseller CADFEM GmbH from 2007-2010 where he was responsible for multiscale material modeling with the software for engineering applications. Seyfarth holds a Diploma in Chemistry from the Ludwig-Maximilians Universität München and upon graduating with a Ph.D. in Theoretical Chemistry from the University of Bayreuth, he received the Bayer MaterialScience Award for his doctoral thesis. He currently has more than five years of experience transferring micromechanics to the needs of industrial application.

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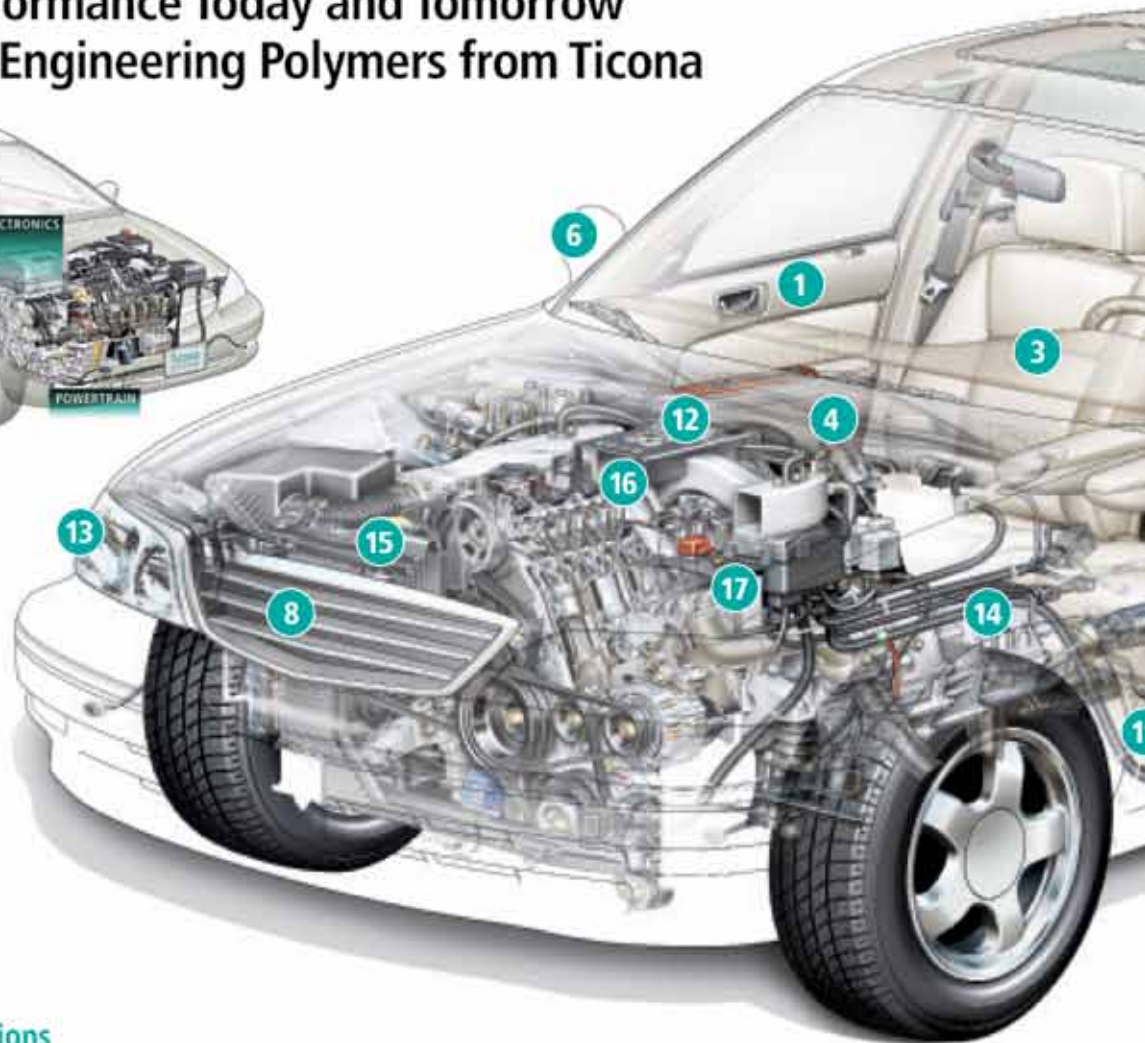
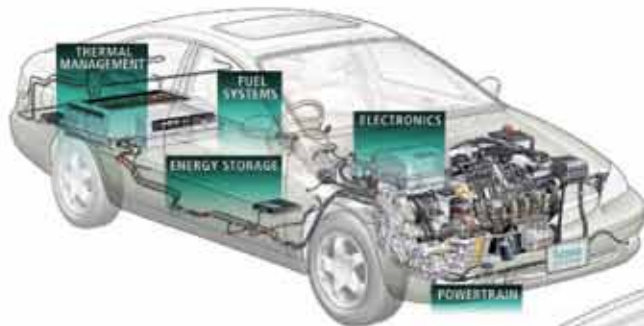
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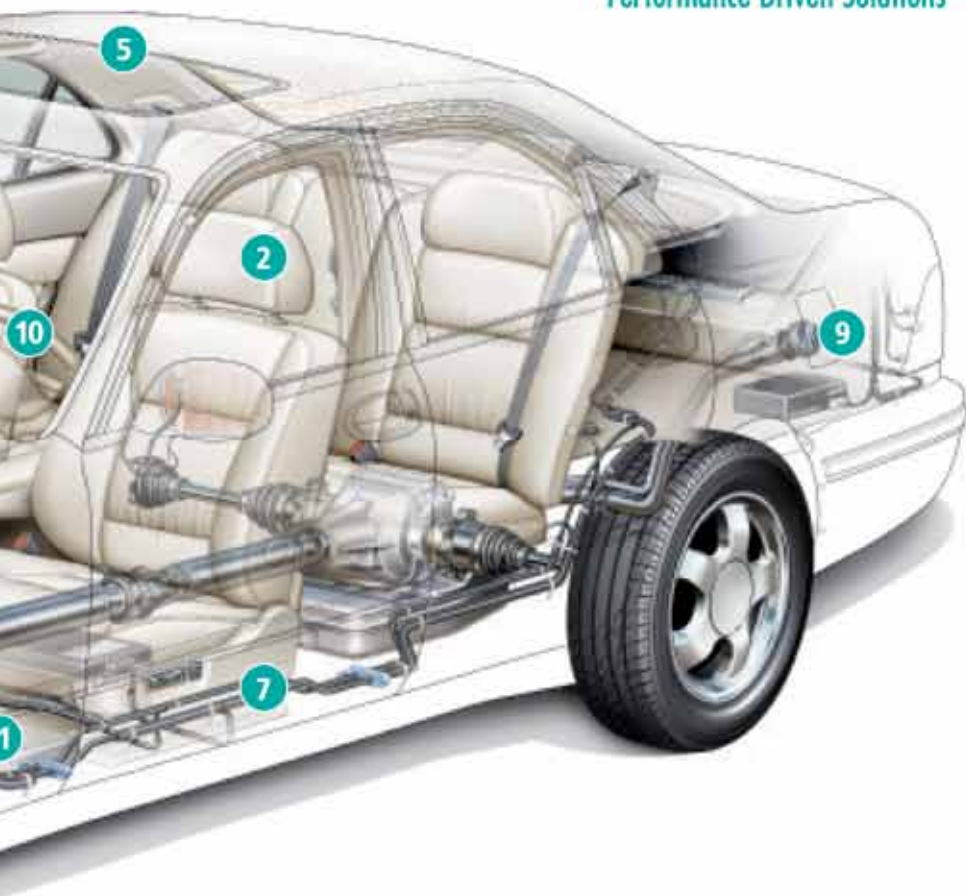
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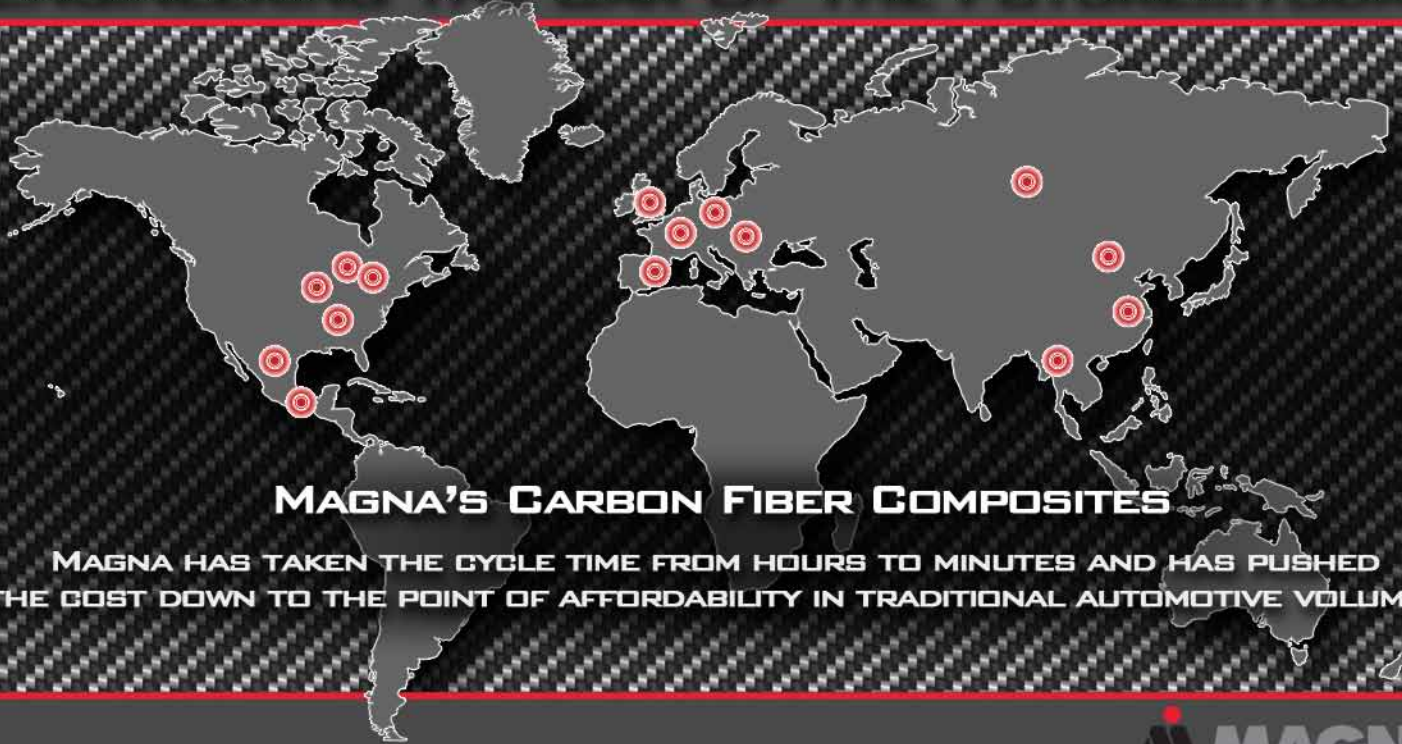
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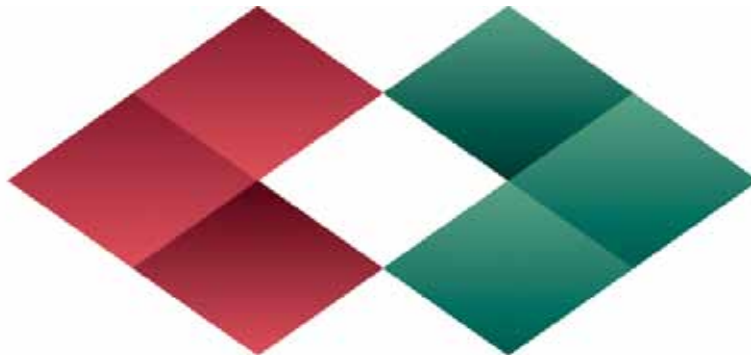
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## Introducing the Winners of 2012-2013 SPE® ACCE Graduate Scholarship Awards

### Winning

students whose composites-intensive projects were judged to have the greatest potential impact on ground transportation in this year's ACCE scholarship competition were John Hofmann, who is working on a doctorate in Macromolecular Science & Engineering at Virginia Polytechnic Institute & State University (Virginia Tech) and Alper Kiziltas who is pursuing a Ph.D. in Forest Resources at the University of Maine. Each student will receive a total scholarship of \$2,000 USD and will return to present the results of his research at next year's SPE ACCE show, September 10-12, 2013.



**John Hofmann's** research will focus on extension of the Method of Ellipses (MOE) for measuring the orientation of long, semi-flexible glass fibers to help predict final fiber orientation in injection-molded parts. He points out that there are numerous commercial benefits of glass-reinforced polymer composites,

which are widely used in numerous industries, including automotive. However, the magnitude of the benefits are highly dependent not only on polymer matrix plus length, type, fiber-volume fraction, and form factor of reinforcement used, but also on processing conditions and final fiber orientation in the part.

Hofmann adds, "The primary thrust of my research is to evaluate the feasibility of extending the Method of Ellipses from short, rigid-fiber composites to long, semi-flexible fiber systems. In the coming year, I'll evaluate a number of research objectives, including looking at both short- and long-fiber orientations in complex geometries, possibly making modifications to the traditional method's image analysis width, doing a comprehensive study of experimental fiber orientation behavior in areas like the sprue and immediate entry region of the tool, and looking at long fiber flexibility to develop a method to experimentally quantify the extent of fiber curvature."

After completing a Bachelor's degree in Chemical Engineering at Case Western Reserve University, Hofmann moved on to graduate school at Virginia Tech. He is currently in his fourth year in the Macromolecular Science and Engineering program working towards a Ph.D. He is advised by Dr. Don Baird and works in the Polymer Processing lab in the Department of Chemical Engineering. The main focus of his research is on glass fiber-reinforced injection-molded composites. After graduation, Hofmann plans to head to industry but stay in research.

**Alper Kiziltas** plans to explore the use of engineering thermoplastics reinforced with natural fillers for certain automotive underhood applications where conditions are too severe for



commodity plastics. Using a combination of microcrystalline cellulose, wood flour, hemp, flax, and kenaf fibers to replace conventional reinforcements such as glass fiber, carbon fiber, nanoclay, and minerals, he hopes to be able to formulate high specific-strength and modulus materials that are low-cost, low-density, easy-to-process, offer thermal and acoustic insulation, easy surface modification, low abrasion to molds, biodegradability, renewability, and global availability. He will concentrate on polyamide (PA, also called nylon) 6 and 6/6 as well as a blend of polyethylene terephthalate (PET) and polytrimethylene terephthalate (PTT).

Kiziltas adds, "The common belief is that natural filler reinforcements for thermoplastics are limited to low-melting commodity thermoplastics with melting points below 180°C rather than higher temperature, higher performance engineering thermoplastics with higher melting points of 220°C or above. My research and patent applications have previously demonstrated that these beliefs are untrue. I have succeeded in making thermoplastic composites combining microcrystalline cellulose (MCC) using nylons and thermoplastic polyesters with melting points above 220°C and 260°C respectively. In the next phase of my research, I'll produce engineering thermoplastic composites with various natural fiber reinforcements and MCC and then evaluate their resulting thermal and mechanical properties."

Upon obtaining an undergraduate degree in Forest Products Engineering from Karadeniz Technical University, Trabzon, Turkey, Kiziltas was awarded a prestigious scholarship from the Turkish government to attend graduate school at the Karadeniz Technical University Graduate School. In the Spring of 2006, the Republic of Turkey/Ministry of National Education awarded him a full scholarship to pursue graduate studies in wood science and technology in the United States. He enrolled in the School of Forest Resources at the University of Maine in the fall of 2007, obtained a Master's of Science degree in August of 2009, and is currently enrolled in the School of Forest Resources' Ph.D. program from which he expects to graduate next year. After school, Kiziltas hopes to work in automotive research developing natural fiber-reinforced components for passenger vehicles.

Hear Hofmann present *The Effect of Glass Fiber Length on Orientation Distribution within Center & End Gated Injection Molded Composites* in the Virtual Prototyping & Testing session (Amphitheater 102) on Tuesday, September 11 from 10:00-10:30 a.m.

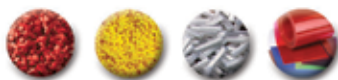
Kiziltas will present two papers on Tuesday, September 11 in the Bio & Natural Fiber Composites session: *Natural Fiber Blends Filled Engineering Thermoplastic Composites for Automobile Industry* from 1:15-1:45 p.m. and *Utilization of Carpet Waste as Matrix in Natural Fiber-Filled Engineering Thermoplastic Composites for Automotive Applications* from 2:15-2:45 p.m.





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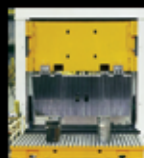
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## 2012 SPE® AUTOMOTIVE COMPOSITES CONFERENCE FEATURES TWO POST-EVENT R&D CENTER TOURS

To provide additional educational and networking opportunities, SPE ACCE organizers have teamed up with two organizations to offer R&D center tours after the conference ends.

The tours are free, but participation is limited and only available to those attending the 2012 SPE ACCE. *Check with the front desk to see if there are any more openings left for either tour.*

### TOUR 1: Thursday Afternoon Sept. 13, 4:30-7:00 p.m.: Plasan Carbon Composites R&D Center Wixom, Michigan, U.S.A.

Plasan Carbon Composites is North America's leading automotive tier 1 supplier of paint-line ready, Class A body panels, assemblies, and structural components in carbon fiber composites – materials renowned for significantly reducing mass, part count, assembly steps, and warranty costs while greatly increasing design freedom and optimizing package space.

During a 1-hour tour of the company's new R&D center in Wixom, see carbon composite parts molded on a new out-of-autoclave process developed jointly by Plasan and Globe Machine Manufacturing Co. Then, enjoy a reception where light snacks and beverages will be served.



### TOUR 2: Friday Sept. 14, 8:30 a.m.-5:00 p.m.: Fraunhofer Project Centre for Composites Research at Western University (FPC@Western), London Ontario, Canada

FPC@Western is an independent not-for-profit research platform for North American industry to investigate the potential of lightweight fiber-reinforced composites and advanced process technologies. The center's goal is to help accelerate adoption of high-volume composites technologies in industrial sectors like automotive, ground transportation, renewable energy, construction, aviation, and machinery/equipment. It benefits from its position in the heart of the Canadian automotive industry and its proximity to major North American automobile assembly and research centers nearby in the Detroit area.

After a 3-hr ride, enjoy lunch and an overview of the new center's purpose and resources, then walk the new facility and view composites processing equipment and speak with process and materials experts about their latest work in composites research.





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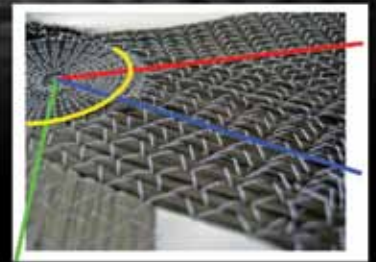
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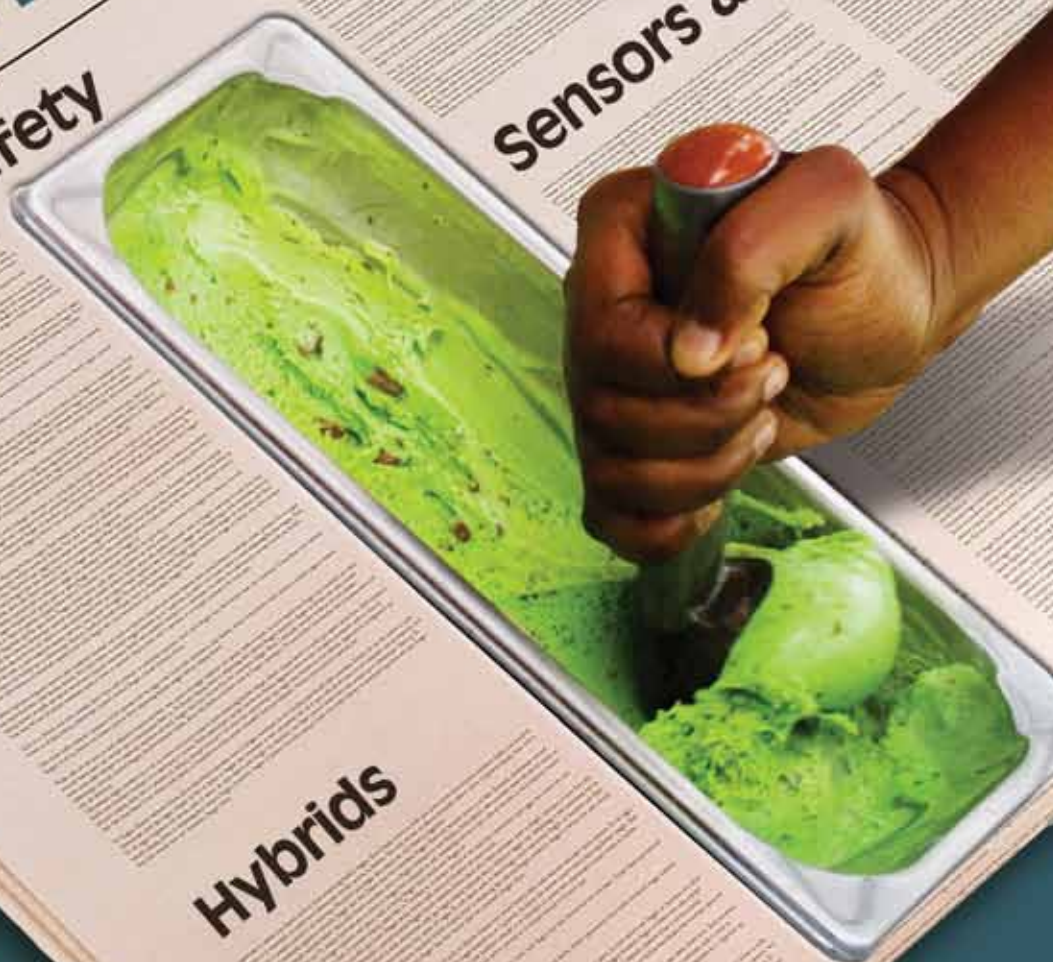


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# TWO PANEL DISCUSSIONS HIGHLIGHT DESIGN, ASSEMBLY, SIMULATION ISSUES INVOLVING MULTI-MATERIAL VEHICLES

*Year* after year, attendees report that panel discussions are among the most popular aspects of the SPE ACCE show, and we expect this year will be no different. We have two panels the first two nights of the conference and each seeks to continue the day's dialogue on how best to incorporate composite components in today's as well as tomorrow's automobiles. Audience members will have the opportunity to ask panel participants questions during the last 30 minutes of each panel discussion. Details on this year's panels follow. We hope to see you in the audience.

## PANEL DISCUSSION 1: Tue., Sept. 11, 4:00-5:30 p.m. Design & Assembly of the Multi-Material Car

### Overview

Incorporating composites into the body-in-white (BIW) structure of vehicle designs and in assembly processes that have been optimized around stamped steel is a challenge on many levels. Compatibility with E-Coat, room to assemble after the body shop, maintaining build tolerances, and new methods of joining are among the complex challenges that arise from the manufacturing side. From a design perspective, understanding the crash behavior of structures that feature composites and metals, plus fatigue – both of which are related to the performance of the joining method used – and developing new CAE data that are representative of the vehicle system are challenges from the design side of the business. Other issues that need to be understood and addressed include stiffness, coefficient of linear thermal expansion (CLTE), achieving Class A finish, and historic hurdles encountered when combining polymeric and metallic components in vehicle designs. This panel attempts to review past lessons in order to dialog about possible new pathways that could help the automotive industry meet today's cost, weight, assembly, and design challenges with multi-material vehicle assemblies.

### Moderator

**Lindsay Brooke**, Senior Editor, SAE International's *Automotive Engineering International* magazine

### Panelists

**Saad Abouzahr**, Senior Manager- Materials Engineering, Chrysler Group LLC;

**Jay Baron**, President, CEO, and Chairman of the Board, Center for Automotive Research (CAR);

**Oliver Kuttner**, Chief Executive Officer and Co-Founder, Edison2;

**Gary Lownsdale**, Chief Technology Officer, Plasan Carbon Composites;

**Tom Pilette**, Vice President Product & Process Development, Magna Exteriors & Interiors;

**George Ritter**, Principle Engineer-Adhesives, EWI

## PANEL DISCUSSION 2: Wed., Sept. 12, 4:15-5:45 p.m. Challenges & Opportunities with Predictive Analysis of Multi-Material Automotive Structures

### Overview

Global economic and environmental challenges have been translated into a set of government regulations aimed at increasing fuel economy (U.S. CAFE standards of 54.5 miles/gal by 2025) and reducing CO2 emissions (EU target of 95 g/km by 2020). The challenge of increasing fuel economy and reducing emissions necessitates this industry jointly tackle improvements to power-train efficiency and reduction of vehicle mass. The real impact of composites on vehicle lightweighting will not be seen until they are used to replace significant metallic structures on the vehicle body. However, those semi-structural and structural applications are not advancing as fast as many would like in large part due to concerns that virtual design and analysis tools for predictive engineering are not yet sufficiently well developed to enable accurate process and crash modeling of composite parts. Unlike metals, which are essentially homogeneous, isotropic, linear, and mostly independent of their forming process and therefore much easier to model and predict, composites are heterogeneous, anisotropic, non-linear, and are highly affected by their molding process and even where a part is gated. Add to this the plethora of thermoplastic and thermoset matrices and types of single and hybrid reinforcements and the situation becomes vastly more complex. Computer-aided engineering (CAE) software, numerical methods, simulation processes and analyst expertise must thus be adapted to think and design fully for and with composites. This panel will discuss the analytical tools available to predict the behavior of composite structures.

### Moderator

**Doug Smock**, Reporter, *PlasticsToday.com* and Editorial Director, *TheMoldingBlog.com*

### Panelists

**Roger Assaker**, Chief Executive Officer, e-Xstream engineering

**Fouad el Khaldi**, Industry Strategy & Innovation, ESI Group

**Hannes Fuchs**, Principal Engineer- Composites, Multimatic Engineering

**Mark Minnichelli**, Director-Technology and Development, Engineering Plastics, BASF Corp.

**Tim Palmer**, Manager, Presales - Field Technical Support, MSC Software

**Jeff Webb**, IP and Console Technical Specialist / Interior CAE Supervisor, Ford Motors Co.



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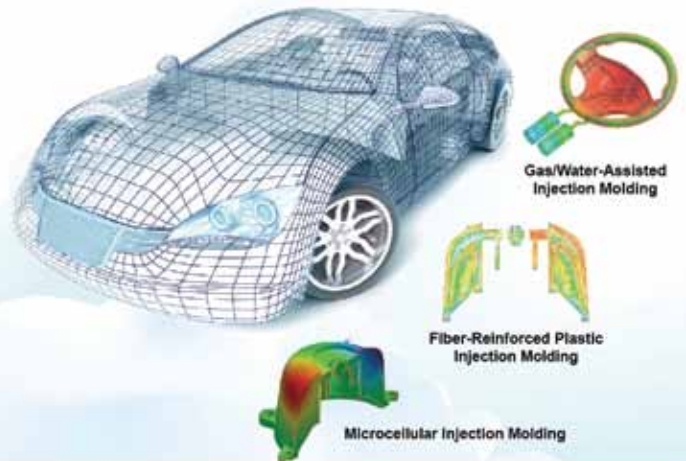
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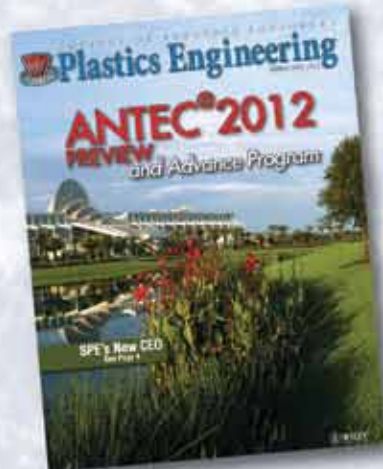
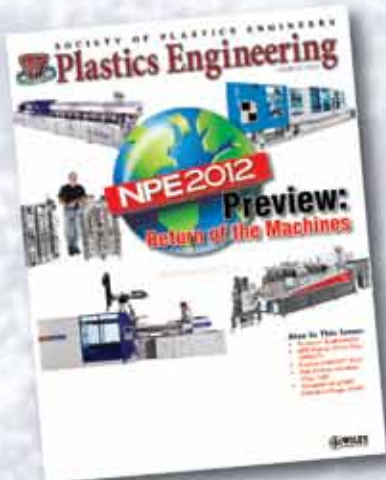
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# PPG's Creig Bowland Named 2012 SPE® Composites Person of the Year



## *Composites Person of the Year*



The SPE® Composites Division has named Creig Bowland, Long-Fiber Thermoplastics (LFT) Technical Leader and Research Associate at PPG Industries, the 2012 recipient of the group's prestigious *Composites Person of the Year* award. Bowland is being recognized for his contributions to the SPE Composites Division and the broader composites industry at this year's SPE® *Automotive Composites Conference & Exhibition*.

First given in 2004, the *Composites Person of the Year* award publicly acknowledges a contributor who has provided significant aid to the SPE Composites Division, particularly during the prior year, as well as made broader contributions to the composites industry as a whole. Nominations are reviewed by the board and one recipient is selected by the current division chair in consultation with the current awards chair. Previous winners of the award include:

Dan Buckley of American GFM, John Muzzy of the Georgia Institute of Technology, James Griffing of The Boeing Co., Fred Deans of Allied Composite Technologies LLC, Peggy Malnati of Malnati & Associates LLC, Dale Grove of US Silica, and Dale Brosius of Quickstep Composites LLC.

Explaining how Bowland was selected as this year's award recipient, current SPE Composites Division chair, Dale Brosius – who is president of his own consulting company as well as president of Quickstep Composites LLC, the U.S. subsidiary of Quickstep Technologies of Australia – explained, "We looked at Creig's leadership of the SPE ACCE show last year, which enjoyed record attendance and sponsorship in 2011 right after some of the toughest years this industry has seen in several decades. We also considered his leadership and management of issues with the show this year as the organizing committee strove to deal with a longstanding issue of space constraints. While he championed the move to consider a new and larger venue for the show after 11 years in the same location, he listened to his team and sought creative solutions to both solve the problem and provide continued value to attendees, exhibitors, and presenters at the existing location. Last, but certainly not least, we wanted to recognize his willingness to become Division Councilor for the next three years with our parent society."

Creig Bowland has over 20 years' experience in the design and production of composite materials for both aerospace and automotive markets. He has been involved in almost all aspects of the composites business, including materials design, production management, technical support, business development, and marketing. His area of expertise is the design and use of LFT composites for structural parts. Bowland holds a B.S. degree in Chemistry from Colorado State University and an M.S. degree in Physical Chemistry from the University of New Mexico. He is the Past Chair of the SPE Composites Division, has been the 2011 and 2012 SPE ACCE Event Chair, and was the SPE ACCE Technical Program Co-Chair in 2010.



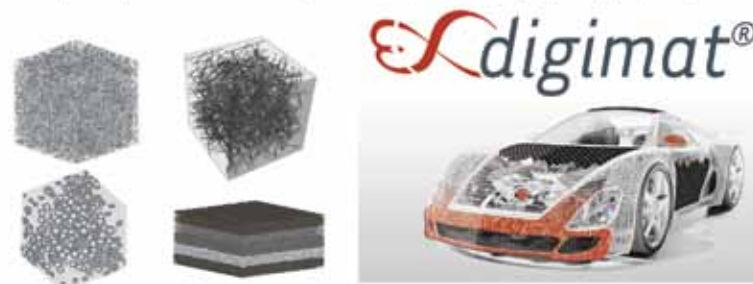
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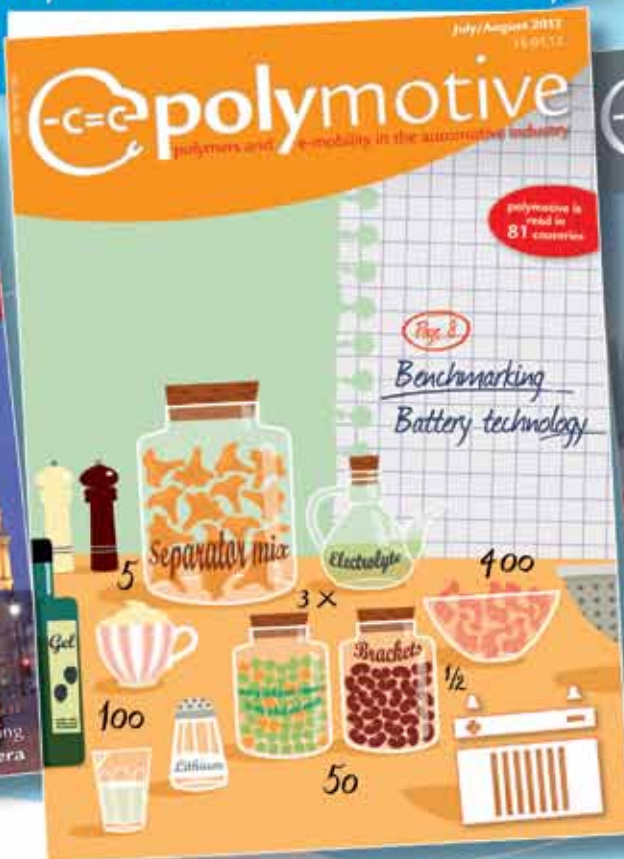
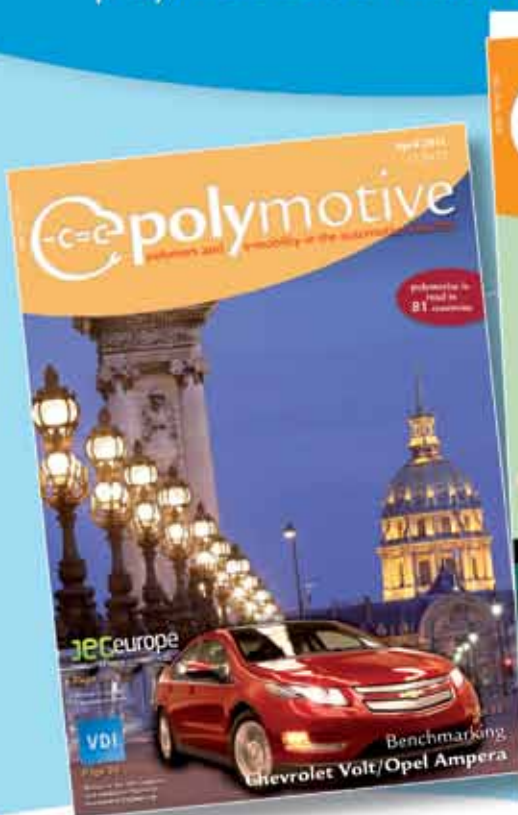
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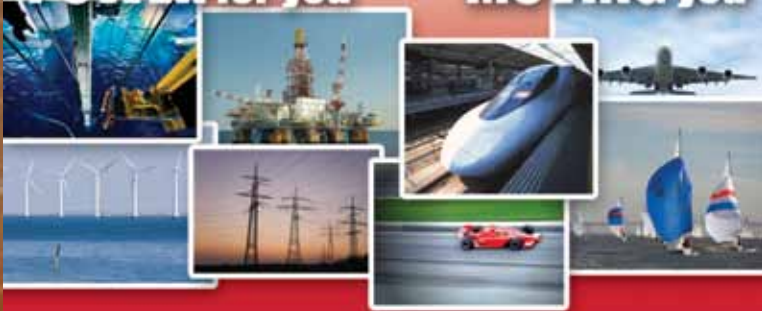
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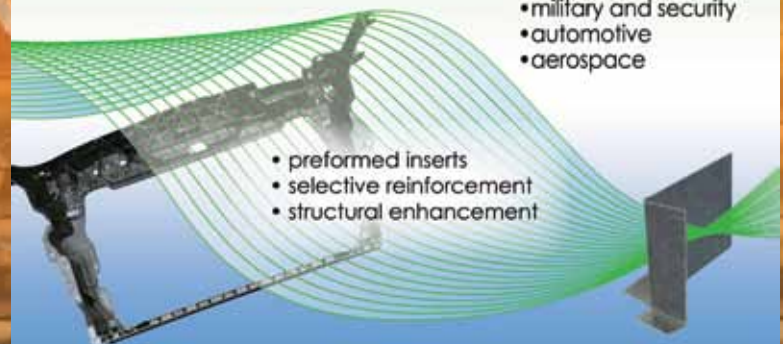
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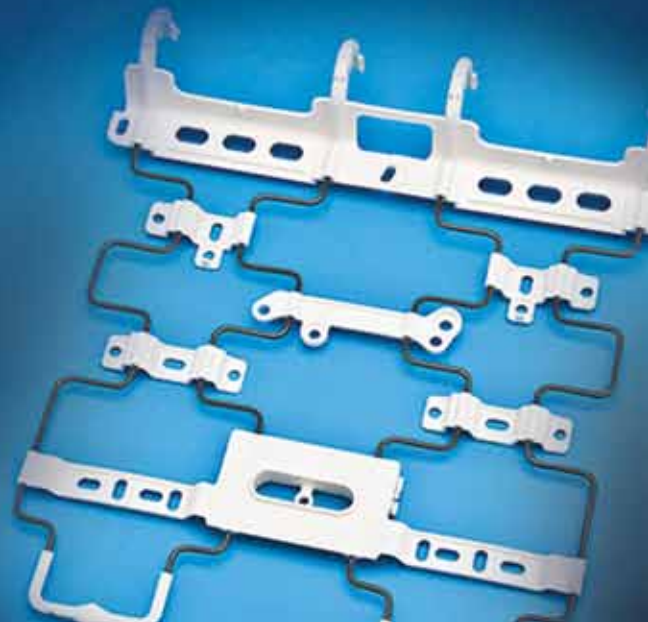




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## 4<sup>TH</sup>-ANNUAL SPE® ACCE STUDENT POSTER COMPETITION

*For* the fourth time in as many years, the SPE® ACCE is hosting a student poster competition showcasing emerging technologies in the area of automotive and ground-transportation composites. This year's competition features 16 graduate students from 10 universities – the largest pool of entrants yet. The competition is being co-sponsored by SPE's Automotive and Composites Divisions (who co-organize the conference). Students of winning posters judged to be in the Top 3 of the show will receive monetary awards and plaques. All students will be recognized and winners will be awarded in a ceremony on the second day of the conference.

Judges made up of media, industry experts, and SPE board members will review all posters on the first day of the conference. Students and their posters will be judged on 10 aspects, including:

- **content** (student and poster demonstrate clarity of topic, objectives, and background);
- **motivation** for research and technical relevance to conference theme;
- **methodology** and approach to problem;
- **quality** of proposed research results/findings;
- **conclusion** are supported by information presented);
- **presentation** (display aesthetics are pleasing; there is a logical flow between sections);
- presenter has a good grasp of the subject; plus
- **understandability** of poster, which is effective even without student being present to explain it); and overall rank vs. other posters and presenters.

The SPE ACCE poster competition is organized annually by Dr. Uday Vaidya, SPE Composites Division Board Member and Education Chair, and Professor and Director-Engineered Plastics & Composites Group in the Department of Materials Science & Engineering at University of Alabama at Birmingham (UAB).

Topics, student authors, and schools include:

- *Microcrystalline Cellulose Fiber-Filled Engineering Thermoplastic Composites for Automotive Applications*, Alper Kiziltas, Douglas J. Gardner and Yousoo Han, **University of Maine**
- *Evaluation of Coal Fly Ash as a Filler for Thermoplastic Polymer Composite Blends*, Kendal Novak, Scott Shermataro, and J. David Schall, **Oakland University**
- *Cure Kinetics of Partially Bio-Based Polyester Resins with Variable Mixtures of Peroxide Initiators*, Eldon D. Triggs II, **Tuskegee University**
- *All Composite Liner-less CNG Tanks for Transportation and Storage*, Aaron Laney, **Oklahoma State University**

- *Improvement of Fire Retardancy and Durability of Recycled Post-Consumer Carpet*, Aaron Laney, **Oklahoma State University**
- *Prolonging the Structural Integrity of Poly-Lactic Acid Based Natural Fabric Composites*, Zachary Block, **Winona State University**
- *Utilization of Hybridized Fiber Lay-Up in Biobased Sandwich Structures for Mass Transit Applications*, Sethu Munusamy, **North Dakota State University**
- *Thermoplastic Pultrusion Modeling and Experimental Studies*, Khongor Jaamiyana, **University of Alabama at Birmingham**
- *Investigation on Tensile and Thermal Properties of MWCNT Modified Carbon /Epoxy Composites*, Nusrat Jahan, **Tuskegee University**
- *Investigation on the Effect of Fabrication Technique on the Microstructural and Mechanical Properties of the Nickel based Metal Matrix Composite*, Tharaka Chandanayaka, **North Dakota State University**
- *Effect of Changing Molecular Weight Between Crosslinks on Material Properties A Molecular Dynamics Study*, Christopher Childers, **University of Southern Mississippi**
- *Grain Boundary Coalescence in Binary Alloys Using Phase-field Crystal Model*, Elizabeth Rowan, **McMaster University**
- *Temperature Effects on the Impact Performance of Self-Reinforced Polypropylene Composite Laminate*, Sean Severson, Benjamin Willis, **Washington State University**
- *Flax and Hemp Fiber Thermoplastic Composites Process-Performance Correlations*, Theresa Bayush, **University of Alabama at Birmingham**
- *Composite Tooling from Recycled Post-Consumer Carpet*, Ranji Vaidyanathan, **Oklahoma State University**
- *Development and Characterization of Carbon/Carbon Nanographene Composites*, Dhruv Bansal, **University of Alabama at Birmingham**

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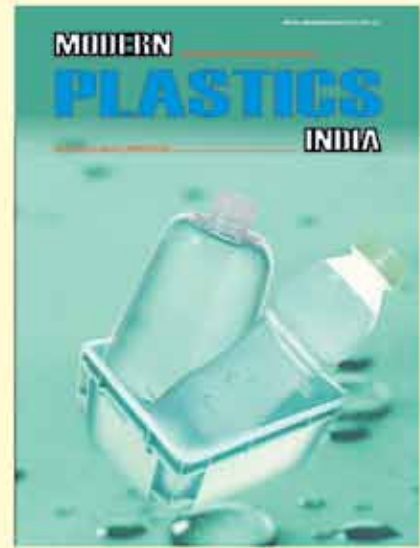
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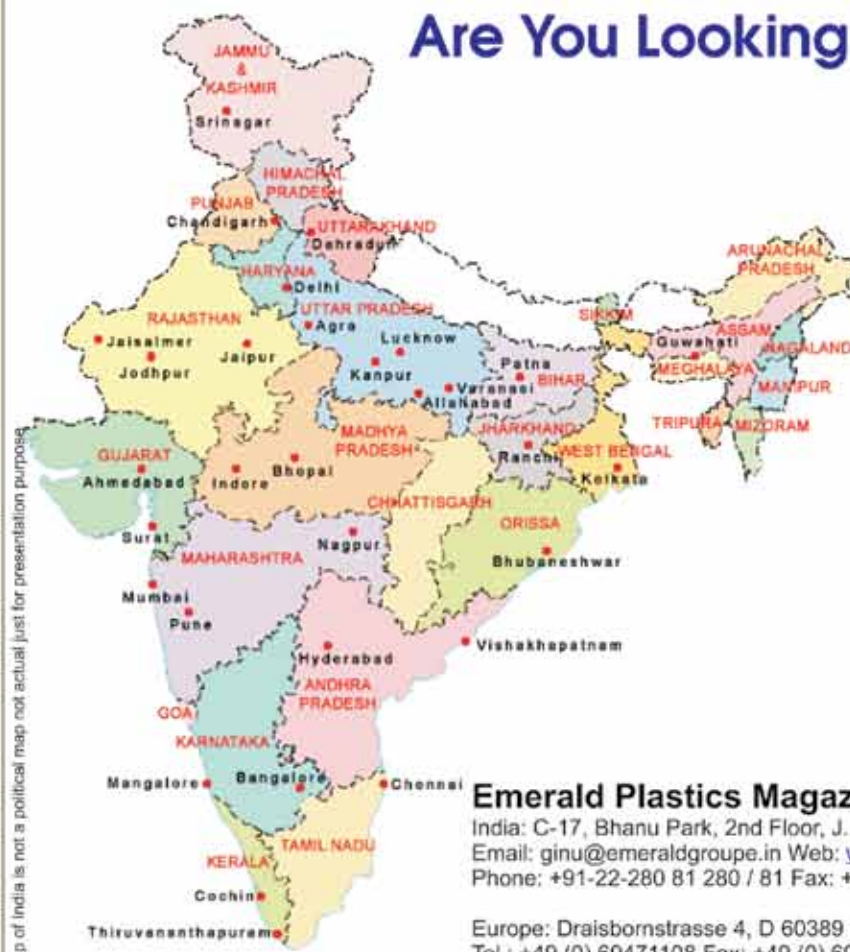
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