AUTOMOTIVE PLASTICS NEWS
A PUBLICATION OF THE AUTOMOTIVE DIVISION OF THE SOCIETY OF PLASTICS ENGINEERS
March 2012 - Volume 41, Issue 3

AutoEPCON Focuses on Enhancing Performance

Whether it's through current offerings, new and higher performance grades or their emerging role as a matrix in advanced composites; engineering plastics are changing the way vehicles are conceived and designed. There is only one conference that focuses solely on the enhanced performance possibilities of engineering plastics, and that's SPE AutoEPCON.

The seventh annual SPE AutoEPCON will be held May 1 at the MSU Management Education Center, Troy, MI with four top level keynote addresses and over 14 technical papers on new materials, predictive engineering techniques and innovative applications for cost, weight and performance.

Highlighting this year's conference are the following keynote presentations:

Dr. David Cole, Chair Emeritus of the Center for Automotive Research, will give his insights on how the industry's future is changing for the better in a talk entitled, The Auto Sun is Rising.

Dr. Alan Taub, Vice President of Global Research and Development, General Motors Co., will highlight challenges for materials with the fundamental changes coming in vehicle function, design and propulsion. His presentation is entitled Advanced Automotive Materials: The New DNA of Personal Mobility.

Maria Ciliberti, Americas Business Manager, Ticona Engineering Polymers, returns from her management assignment in Europe to overview how engineering plastics are poised to boost vehicle mileage and performance in a revitalized industry. Her talk is entitled, "The Automotive Renaissance: Re-Inventing Transportation."

Kathy Minnich, Manager, Materials Engineering and Testing, Ford Motor Company, will capture the drivers and probe the evolving expectations of OEM materials engineers and material suppliers in her presentation, Material and Supplier Selection: Global Challenges and Evolving Expectations.

"We've seen this conference grow each year with outstanding executive management and technical presentations that address what it takes to innovate and succeed in this increasingly fast-paced, global auto industry. Our 2012 conference theme is Enhanced Performance with Engineering Plastics and the event promises to be the best ever," said Nippani Rao, chair of SPE AutoEPCON.

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Automotive Division Meeting Schedule and Special-Events Calendar

ANTEC 2012 Orange County Convention Center Orlando, Florida USA	April 2-4, 2012
Automotive Division BOD Meeting—All invited ! American Chemistry Council, Troy, MI	April 16, 2012
AutoEPCON MSU Education Center Troy, MI	May 1, 2012
Automotive Division BOD Meeting—All invited ! American Chemistry Council, Troy, MI	June 18, 2012
Automotive Composites Conference & Exhibition (ACCE) MSU Education Center, Troy, MI	September 11-13, 2012
Innovation Awards Program Burton Manor, Livonia, MI	November 7, 2012

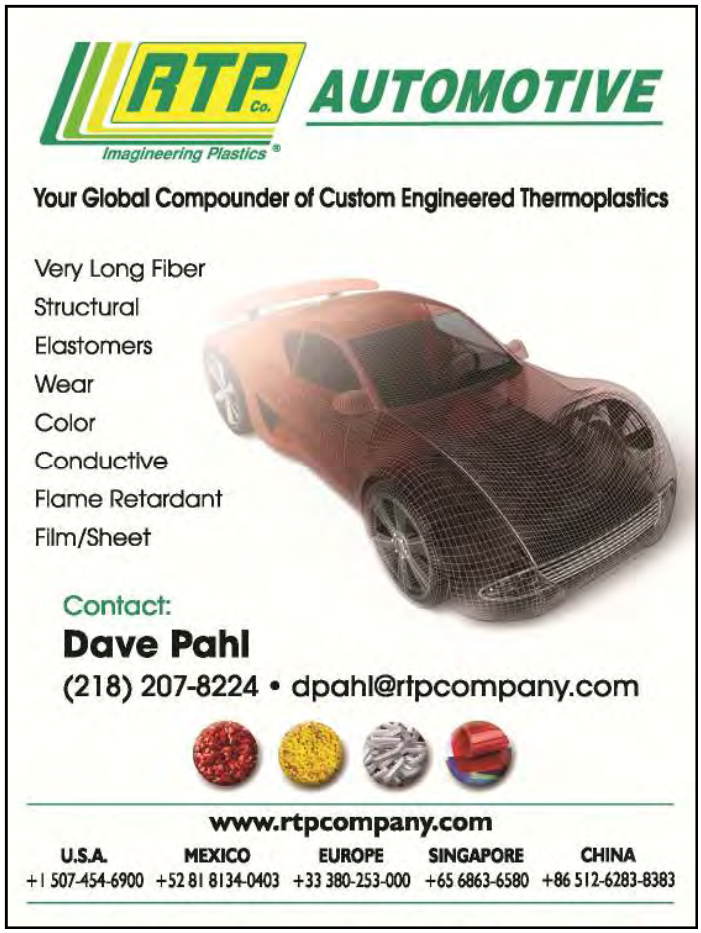
Automotive Division Board of Directors meetings are open to all SPE members. All our events are listed on our website at
http://speautomotive.com/ec
Call Anthony Gasbarro at (248) 721.0276 for more information.

College Scholarships for Sons & Daughters of SPE Members

SPE Detroit Section is now accepting Scholarship Applications from qualified applicants pursuing undergraduate in engineering or science.

Detroit Section and Automotive Division member's children who are pursuing a degree course are eligible. More details and requirements are provided in the application.

Last date to submit an application is September 30, 2012. For more information, please contact nippanirao@aol.com or check on the Detroit Section web site, www.spedetroit.com



Chair's Message

Anthony Gasbarro

Well as this newsletter reaches you we might just be out of Winter and into Spring. At the Automotive Division of the SPE we are just starting to gear up for some events that will carry us through the year. I hope that you are inspired and willing to help out.

In case you were not aware – I cut and pasted a section from our Website which shows what our Goals as the Automotive Division are – I ask you to give us some feedback – are we meeting these goals in your mind?

The Division's first goal is to "inform and educate" the public and potential members about plastics by being a central source for information and contacts through:

- Establishment of an easy of access information network
- Strong educational/informational-based programs and conferences
- Responsiveness to customer feedback
- Partnerships with SPE divisions and other organizations.

The second goal of the Automotive Division is to "communicate" with the automotive community to:

- Inform our audience, including, SPE members, students, OEMs, Suppliers, and
- Interested Partners of the resources within SPE AD
- To provide highly effective and responsive service to our members.

The third goal of the Division is to "implement and execute" the goals of our mission through:

- Individual Member Involvement in events and activities to support the automotive plastics industry
- Industry Involvement via technical sessions and conferences to promote new and advancing technologies in automotive plastics to the broader automotive and transportation community
- Stability of Division Finances. Manage budgets, resources and events to meet on-going program needs.

Our AutoEPCON, a one day conference on Engineering Plastics, will be held on May 1st at the MSU Management Education Center. Be sure to check out **www.speautomotive.com/emc** for more information. This is typically a must attend event – and I am sure this year won't be any different.
We are also planning in conjunction with other SPE Divisions/Sections:

- ACCE – Automotive Composites Conference Exhibition
- TPO – TPO Automotive Engineered Polyolefins Conference
- IAG – Innovation Awards Gala

As always you can find links to those events at our website **www.speautomotive.com**

I hope you will be joining us at ANTEC (Co located with NPE) in Orlando this year. ANTEC is being held from April 1 – 5 at the Orange County Convention Center in Orlando, Florida – if you ever needed an excuse to take a spring break in Florida – you have one now! You can go to **www.4spe.o**rg for more information.

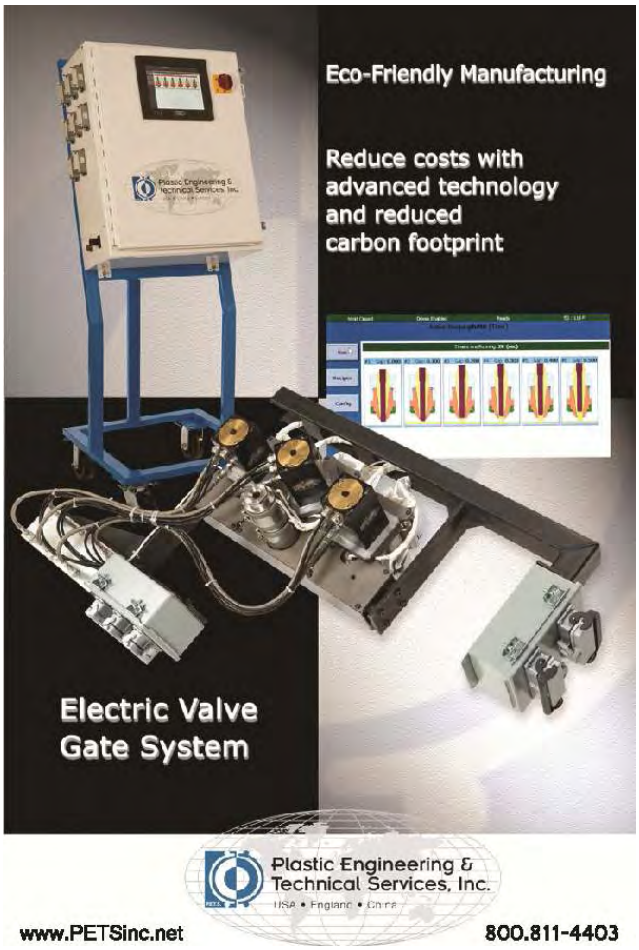
We have a lot of things going, a lot of things to plan, and we have been blessed to have an active group of people that partake in these activities. We are however always looking for more people to help out in various ways. As the saying goes – "many hands make light work."

We will have our next Board of Directors meeting on April 16th at the American Chemistry Council offices on Crooks Rd. in Troy, MI. A call-in number is always provided – please get in touch if you would like more information. We would be happy to help you become involved.

I look forward to seeing more of you at our events. Feel free to contact me at **anthonygasbarro@yahoo.com** if you have any questions or comments about our Division.

Thank you and make it a great day.

Anthony Gasbarro



AutoEPCON

Continued from Page 1

Register soon because seating is limited. Below are key contacts for participating in this unique, one day conference:

Sponsorship:
Dr. Gary Kogowski, Entec Polymers, LLC. 248-797-7433. E-mail: gkogowski@entecresins.com
Dawn Stephens, SPE, 248-244-8993 E-mail: speautodetroit@gmail.com

Exhibits Sign Up:
Bill Windscheif, Advanced Innovative Solutions, Ltd., LLC. (248) 535-2595: bill@AIS-Limited.com
Kelly Beauchamp, D-M-E, (248) 705-4188: kelly_beauchamp@DME.net

Technical Abstracts:
Dr. Norm Kakarala, Inteva Products, (248) 655-8483 and
Sandra McClelland, Chevron Phillips Chemical Co. LP (586)-264-0063
Please send technical abstracts by March 4, 2012 to: nkakarala@intevaproducts.com or mccles@cpchem.com

Advertisement:
Vineet Kapila, Styron, LLC, (248) 408 8499: vkapila@styron.com

Conference Co-Chairs:
Nippani Rao, Chrysler (retired) 248-444-1753: nippanirao@aol.com
Terrence Q. Cressy: terrence.q.cressy@dupont.com

Register: You can pre-register for the conference by contacting Dawn Stephens at 248-244-8993 speautodetroit@gmail.com

Exhibits, Coordination:
Bill Windscheif, Advanced Innovative Solutions, Ltd., LLC. (248) 535-2595.Email: bill@AIS-Limited.com
Kelly Beauchamp, D-M-E, (248) 705-4188: kelly_beauchamp@DME.net

SPE FastTrack training program offers plastics professionals intensive training options

A new spring Society of Plastics Engineers (SPE) FastTrack training program has just been announced. The topics have been designed to enhance injection molding, extrusion molding, blow molding and thermoforming knowledge levels regardless of plastics industry tenure.

First-ever course offerings include managing innovation; principles of sustainable business; single-stage reheat blow molding fundamentals; solving the plastic product design and development puzzle; medical device design and processing; materials and testing for thermoforming; permeation fundamentals; and optimizing sheet extrusion thermoforming while reducing stress.

Produced by industry thought-leader Plastic Technologies, Inc. (PTI), the SPE FastTrack training program will be held on May 7-10, 2012 at the Crowne Plaza Atlanta Airport. Participants can elect to sign up for the full four days or choose from an “ala carte course menu” to better suit their area(s) of interest.

“The course material has been designed so that it is of value to veterans, industry newcomers and anyone in between. For the veterans, we view this as an excellent refresher. For the newcomers, the information will help add to their knowledge base,” said Scott Steele, president, PTI.

Course tracks include: injection molding; extrusion; blow molding; thermoforming; industrial and medical part design; mold fundamentals and advanced injection molding; blow mold design, part quoting, snap/press fits and thermoforming optimizations; and managing innovation and sustainability

“The course material will be presented by subject matter experts. Instructors will not only be discussing current technologies, but they will also be offering their considerable insight on what they expect to be happening in the future,” Steele said. “Additionally, the small class size facilitates interaction and enhances the learning experience.”

Fees range from $695 for a single day to $2,390 for participation in a full four-day track. Discounts are available for groups of three or more. Fees include materials, continental breakfast, lunch and beverage breaks. To register, or for more information: www.ptifasttrack.com or call 419 867-5424.

Fuel your brain

SPE FastTrack training program

Produced by Plastic Technologies, Inc

May 7- 10, 2012
Crowne Plaza Atlanta Airport
1325 Virginia Avenue
Atlanta, Georgia 30344

To register or for more information:
www.ptifasttrack.com
1-419-867-5424

PTI PLASTIC TECHNOLOGIES, INC.

Do you want to be up-to-date on the latest technology? Can your company benefit from the latest plastic materials and processing knowledge? Then the SPE FastTrack training program is the place you need to be. Produced by industry thought-leader Plastic Technologies, Inc., the program offers different study tracks (injection molding, blow molding, thermoforming and new technology) for basic, intermediate and advanced levels. (Or you can pick and choose to customize your own course study.)

Track 1: Injection molding
Instructors: Robert Beard, Len Czuba, Suhas Kulkarni

Track 2: Extrusion
Instructors: Dan Cykana , Pravin Shah, Tim Womer

Track 3: Blow molding
Instructors: John Bower, Scott Steele, Michelle Stevens

Track 4: Thermoforming
Instructors: Robert Browning, Don Hylton

Track 5: Part design for industrial and medical applications
Instructors: Len Czuba, Vishu Shah

Track 6: Mold fundamentals and advanced injection molding
Instructors: Bob Dealey, Larry Schmidt

Track 7: Blow mold design, part quoting, fits and thermoforming optimizations
Instructors: Robert Beard, Gerald Hobson, Tim Womer

Track 8: Managing innovation, sustainability and bio polymers
Instructors: Bonnie Bachman, Edwin Tam

The Automotive Division of the Society of Plastics Engineers (SPE®) today announced the date, location, and theme for its 42nd-annual ***Automotive Innovation Awards Gala***, the oldest and largest recognition event in the automotive and plastics industries. This year's event will be held **Wednesday, November 7, 2012** at Burton Manor (**www.burtonmanor.net**) in Livonia, Mich.

Jeffrey Helms, global automotive director, Ticona Engineering Polymers, who returns as the 2012 ***SPE Automotive Innovation Awards*** chair said, "With automakers facing tougher emissions and fuel-economy standards in nearly every geography, and vehicle *lightweighting* a key strategy for hitting those numbers, this year's theme is ***Plastics Drive 54.5.*** Plastics and composites are the real lightweight materials and they can help transportation OEMs improve vehicle range – whether you're driving a conventional internal combustion engine, a hybrid, or a plug-in electric vehicle. With polymers, you can also reduce costs, eliminate secondary operations, improve aesthetics, and better manage energy in a crash for better passenger safety. By drawing attention to how plastics can help automakers meet new U.S. Corporate Average Fuel Economy (CAFE) regulations of 54.5 miles/gallon required by the year 2025 as well as maintain other important benefits, we at the SPE Automotive Division hope to help drive higher plastics use in tomorrow's passenger vehicles."

SPE's Automotive Innovation Awards Program is the oldest and largest competition of its kind in the world. Dozens of teams made up of OEMs, tier suppliers, and polymer producers submit nominations describing their part, system, or complete vehicle and why it merits the claim as the Y*ear's Most Innovative Use of Plastics*. This annual event typically draws 600 to 800 OEM engineers, automotive and plastics industry executives, and media. As is customary, funds raised from this event are used to support SPE educational efforts and technical seminars, which help educate and secure the role of plastics in the advancement of the automobile.

The mission of SPE is to promote scientific and engineering knowledge relating to plastics worldwide and to educate industry, academia, and the public about these advances. SPE's Automotive Division is active in educating, promoting, recognizing, and communicating technical accomplishments for all phases of plastics and plastic based-composite developments in the global transportation industry. Topic areas include applications, materials, processing, equipment, tooling, design, and development.

For more information about the ***SPE Automotive Innovation Awards Competition and Gala*** or to download nomination forms and rules for this year's competition, please visit the ***SPE Automotive Division*** website at **http://speautomotive.com/inno** and **http://speautomotive.com/awa**, or contact the group at +1.248.244.8993, or write SPE Automotive Division, 1800 Crooks Road, Suite A, Troy, MI 48084, USA.

For more information on the ***Society of Plastics Engineers*** or other society events, visit the ***SPE*** website at **www.4spe.org**, or call +1.203.775.0471.

www.speautomotive.com

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China: 12B Gang Tian Industrial Square, Suzhou Industrial Park, China 215021 • Tel: 86.512.6283.8870

SPE Announces theme for 12th Automotive Composites Conference & Exhibition

Troy (Detroit), Mich. – The organizing committee for the SPE Automotive Composites Conference & Exhibition (ACCE) today announced the dates, theme, and location for this year's show and issued its annual Call for Papers. Now in its twelfth year, the SPE ACCE has become the world's leading forum for automotive composites and draws exhibitors, speakers, and attendees from 15 countries on five continents. This year's event, whose theme is Unleashing the Power of Design, returns September 11-13, 2012 to the MSU Management Education Center in Troy, Mich., U.S.A.

Creig Bowland, senior research associate at PPG Industries, and the 2011 and 2012 SPE ACCE conference chair said, "With the global automotive industry growing again after several difficult years, and with a host of tough new emissions and fuel-economy standards looming for the industry to meet, interest in lightweight materials like polymer composites is at an all-time high. Fortunately, the composites industry has a broad portfolio representing a wide range of cost, performance, and processing options from which to choose. Whether automakers are working on low volume/performance platforms, or high volume/economy platforms, they will find materials and process options that will meet their needs. And the best way to keep on top of the very latest technology innovations in this field is to attend the annual SPE ACCE show."

Those interested in speaking at this year's event should submit abstracts by March 31, 2012 to the review committee via **ACCEpapers@speautomotive.com**. Full papers or presentations are due May 31, 2012. Authors who submit papers (not presentations) in the proper format will be considered for the conference's Best Paper Awards, which will be presented during the event's opening ceremony.

Held annually in suburban Detroit, the ACCE draws almost 500 speakers, exhibitors, sponsors, and attendees and provides an environment dedicated solely to discussion and networking about advances in the transportation composites. Its global appeal is evident in the diversity of exhibitors, speakers, and attendees who come to the conference from Europe, the Middle East, Africa, and Asia / Pacific as well as North America. Fully one-third of attendees indicate they work for automotive and light truck, agriculture, truck & bus, heavy truck, or aviation OEM, and another 25% representing tier suppliers. Attendees also represent composite materials, processing equipment, additives, or reinforcement suppliers; trade associations, consultants, university and government labs; media; and investment bankers. The show has been jointly sponsored by the SPE Automotive and Composites Divisions since 2001.

The mission of SPE is to promote scientific and engineering knowledge relating to plastics. SPE's Automotive and Composites Divisions work to advance plastics and plastic-based composites technologies worldwide and to educate industry, academia, and the public about these advances. Both divisions are dedicated to educating, promoting, recognizing, and communicating technical accomplishments for all phases of plastics and plastic-based composite developments, including materials, processing, equipment, tooling, design and testing, and application development.

For more information about the SPE Automotive Composites Conference, visit the Automotive Division's website at **speautomotive.com/comp.htm**, or the Composites' Division website at **compositeshelp.com**, or contact the group at +1.248.244.8993.

For more information on the Society of Plastics Engineers or other SPE events, visit the SPE website at www.4spe.org, or call +1.203.775.0471.

USCAR structural underbody on display at the 2011 SPE ACCE. Over 25 companies and organizations are expected to participate at the 2012 event.

12TH-ANNUAL

AUTOMOTIVE COMPOSITES CONFERENCE & EXHIBITION

World's Leading Automotive Composites Forum

SOCIETY OF PLASTICS ENGINEERS
AUTOMOTIVE & COMPOSITES DIVISIONS

MSU MANAGEMENT EDUCATION CENTER
811 W. SQUARE LAKE RD. TROY, MI USA

Unleashing the POWER of Design

September 11-13 2012

CALL FOR PAPERS

EXHIBIT & SPONSORSHIP OPPORTUNITIES

ATTEND THE WORLD'S LEADING AUTOMOTIVE COMPOSITES FORUM

The Automotive and Composites Divisions of the Society of Plastics Engineers (SPE®) International invite you to attend the 12th-annual SPE Automotive Composites Conference and Exhibition (ACCE), September 11-13, 2012. The show – which has become ***the world's leading automotive composites forum*** – will feature technical paper sessions, panel discussions, keynote speakers, networking receptions, & exhibits highlighting advances in materials, processes, and applications technologies for both thermoset and thermoplastic composites in a wide variety of ground-transportation applications.

PRESENT BEFORE AN ENGAGED, GLOBAL AUDIENCE

The SPE ACCE typically draws almost 500 attendees from 14 countries on 5 continents who are interested in learning about the latest composites technologies. Fully a third of attendees work for an automotive, heavy truck, agricultural / off-road equipment, or aerospace OEM, and roughly a fifth work for a tier integrator. Few conferences of any size offers such an engaged, global audience vitally interested in hearing the latest composites advances. Interested in presenting your latest research? ***Abstracts*** are due no later than March 31, 2012 and ***Papers*** no later than May 31, 2012 to allow time for peer review. E-mail abstracts or papers to ACCEpapers@speautomotive.com. Approved papers will be distributed on a CD to conference attendees and posted on our website after the event.

SHOWCASE YOUR PRODUCTS & SERVICES WITH EXHIBIT & SPONSORSHIP OPPORTUNITIES

A variety of sponsorship packages – including displays, conference giveaways, advertising and publicity, signage, tickets, and networking receptions – are available. Companies interested in showcasing their products and/or services at the SPE ACCE should contact Teri Chouinard of Intuit Group at teri@intuitgroup.com.

FOR MORE INFORMATION

www.speautomotive.com
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AUTO TPO Conference 2012

The fourteenth-annual ***SPE® TPO Automotive Engineered Polyolefins Conference***, the *world's leading automotive engineered-polyolefins forum* will be held **September 30-October 3, 2012** and the group has issued its annual call for papers with **abstracts** due **April 27, 2012** and non-commercial **papers or presentations** due **July 31, 2012** (eMail to **TPOpapers@auto-tpo.com**).

Since 1998, volunteers from the ***Detroit Section*** of the ***Society of Plastics Engineers*** (SPE®) have organized the conference to update attendees on the latest developments in engineered thermoplastic polyolefins (TPOs) and related materials. The show typically draws 500 attendees from around the world and features 40+ technical presentations, panel discussions, keynote speakers, networking receptions, plus exhibits that highlight advances in engineered polyolefin materials, processes, and applications technologies.

To represent the technology changes in the plastics industry during the last decade better, as well to reflect growing interest among the automotive and ground-transportation market segments, the conference has expanded its scope beyond rigid and elastomeric TPOs to include a growing range of thermoplastic elastomers (TPEs) and thermoplastic vulcanizates (TPVs) and that broader perspective is reflected in a slight name change for the event.

Returning event co-chair, Jeffrey Valentage, market developer-Specialty Elastomers Business, ExxonMobil Chemical Co. says, "While the name has changed slightly over the last year, the Auto TPO Conference has the same elements that returning attendees value – quality technical presentations, interesting exhibits, lively panel discussions, timely keynote topics, and an atmosphere that makes networking easy and comfortable."

The expanded conference scope is already being reflected in the event's technical program, which is co-chaired by Dr. Norm Kakarala, Inteva Products LLC and Peter Grelle, Plastics Fundamentals Group LLC. Nine technical sessions are being organized around topics like ***Surface Enhancements*** (co-chaired by Dr. Rose Ryntz, International Automotive Components (IAC) and David Helmer, General Motors Corp.); ***Advances in Automotive Polyolefins*** (co-chaired by Patti Tibbenham, Ford Motor Co., and Neil Fuenmayor, LyondellBasell Industries); ***Part Design, Tooling & Processing*** (co-chaired by Dave Okonski and Charles Buehler, both of General Motors Co.); ***Rigid Polyolefin Compounds*** (co-chaired by Mike Balow, Asahi Kasei Plastics North America and Ermanno Ruccolo, Mitsui Plastics Inc.); ***Understanding TPOs*** (co-chaired by Hoa Pham, Washington Penn Plastics and Tom Traugott, Advanced Composites); ***Automotive Interior Trim & Skins*** (co-chaired by Bob Eller, Robert Eller Associates and Yvonne Bankowski, Ford Motor Co.); ***Lightweight TPO Structural Applications*** (co-chaired by Laura Soreide, Ford Motor Co. and Dr. Jay Raisoni, Adell Plastics); ***Large Part Thermoforming*** (co-chaired by Ed Bearse and Kurt Dubowski); and ***Automotive TPEs*** (co-chaired by Bob Eller and Jeffrey Valentage). The conference's ever-popular ***Executive Panel Discussion*** will also return, moderated by Ron Price of Global Polymer Solutions.

This year's conference returns to the Troy Marriott in the Detroit suburbs. A variety of sponsorship packages are available for companies interested in showcasing their products and / or services.

About the TPO Conference

Since 1998, the ***SPE TPO Automotive Engineered Polyolefins Conference*** has highlighted the importance of rigid and flexible polyolefins throughout the automobile – in applications ranging from semi-structural composite underbody shields and front-end modules to soft-touch interior skins and bumper fascia. Engineered polyolefins have been the fastest-growing segment of the global plastics industry for more than a decade owing to their excellent cost / performance ratio. The show typically draws approximately 500 attendees from 20 countries on four continents who are interested in learning about the latest in rigid and elastomeric TPO as well as TPE and TPV technologies. Fully a third of conference attendees say they work for a transportation OEM, and roughly 20% work for a tier integrator / molder, with the balance from materials or reinforcement suppliers, equipment OEMs, industry consultants, and members of academia.

The mission of SPE International is to promote scientific and engineering knowledge relating to plastics worldwide and to educate industry, academia, and the public about these advances. SPE's Detroit Section is active in educating, promoting, recognizing, and communicating technical accomplishments for all phases of plastics and plastic based-composite developments – particularly in the automotive industry. Topic areas include applications, materials, processing, equipment, tooling, design, and development.

For more information about the ***SPE TPO Automotive Engineered Polyolefins Conference***, to view the conference's evolving technical program, or to register to attend the event, please visit **http://auto-tpo.com** or **http://speautomotive.com/tpo.htm**, or contact the group at +1.248.244.8993.

14TH-ANNUAL

TPO AUTOMOTIVE ENGINEERED POLYOLEFINS DETROIT CONFERENCE®

September 30-October 3, 2012

Call for Papers

Exhibit & Sponsorship Opportunities

2011 Sponsors:

Attend the World's Leading *Automotive Engineered Polyolefins* Forum

Now in its 14th year, the show is the *world's leading automotive engineered polyolefins forum* featuring 40+ technical presentations, panel discussions, keynote speakers, networking receptions, & exhibits that highlight advances in polyolefin materials, processes, and applications technologies as well as a growing range of thermoplastic elastomers (TPEs) and thermoplastic vulcanizates (TPVs). This year's show will be held **Sept. 30-Oct. 3, 2012** at the Troy-Marriott (Troy, Michigan) in the suburbs of Detroit.

Present to the Largest Group of Decision Makers in Automotive Engineered Polyolefins

The *SPE TPO Automotive Engineered Polyolefins Conference* typically draws over 500 attendees from 20 countries on 4 continents who are vitally interested in learning about the latest in rigid and elastomeric TPO as well as TPE and TPV technologies. Fully a third of conference attendees work for a transportation OEM, and roughly 20% work for a tier integrator. Few conferences of any size can provide this type of networking opportunity or put you before such an engaged, global audience vitally interested in hearing the latest olefin advances. Interested in presenting your latest research? **Abstracts** are due **April 27, 2012** and **Papers/ Presentations** in **July 31, 2012**. E-mail abstracts/papers to TPOpapers@auto-tpo.com.

Showcase Your Products & Services at the World's Largest Automotive Engineered Polyolefins Forum

Many sponsorship packages are available. Companies interested in showcasing their products and/or services at the **SPE Auto TPO** should contact TPOsponsor@auto-tpo.com.

For More Information

www.auto-tpo.com or www.speautomotive.com/tpo
Ph: +1.248.244.8993 or email: dawn@auto-tpo.com
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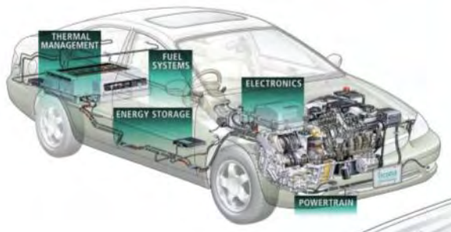

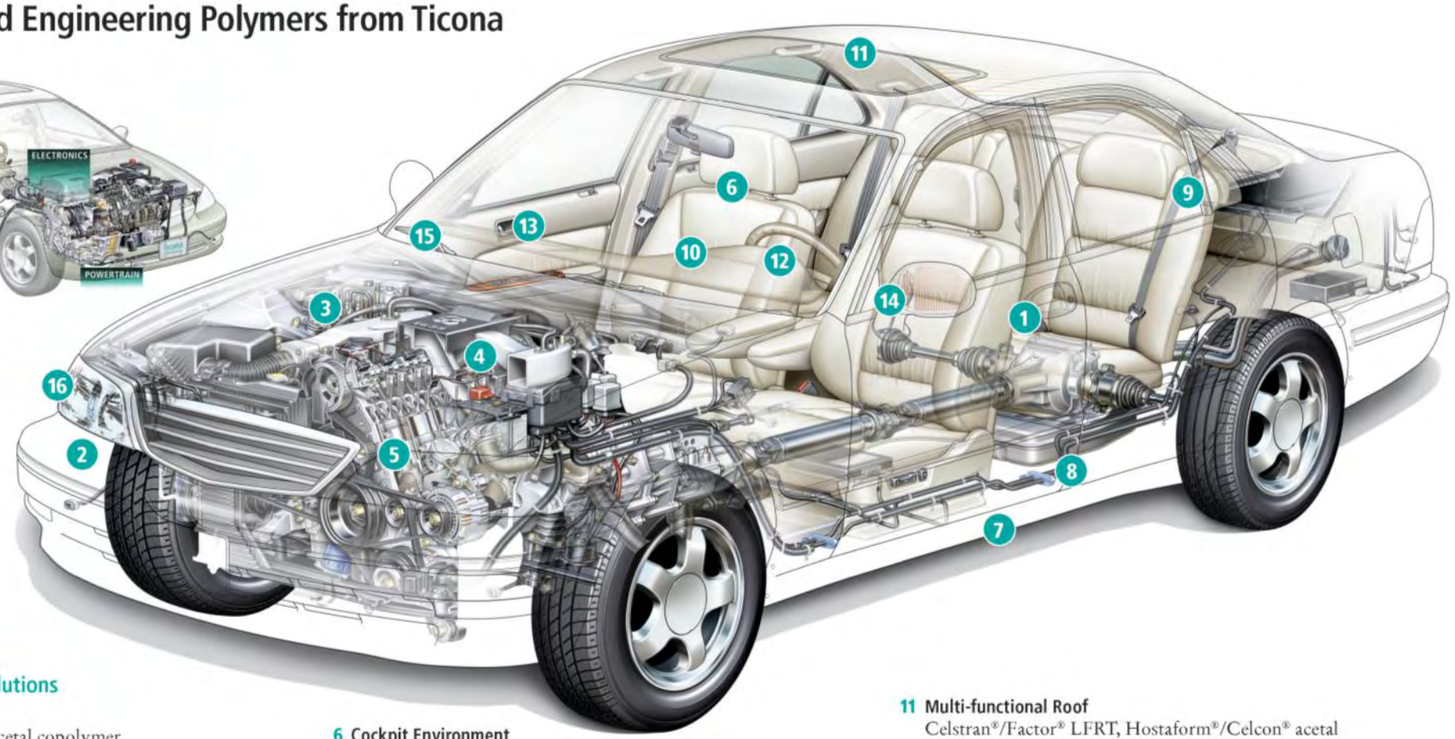

Integrated System Solutions

1 Door/Lock/Window
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2 Front End Modules
Celstran®/Factor® LFRT, Celanex® PBT, Impet® PET

3 Electrical/Ignition
Celanex® PBT, Fortron® PPS, Vectra®/Zenite® LCP, Hostaform®/Celcon® acetal copolymer, Thermx® PCT

4 Power Distribution
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Mechanisms of Interfacial Adhesion in Metal-Polymer Composites

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ABSTRACT

Hybrid materials featuring thermoplastic polymer composites in conjunction with metals can be used as structural materials in commercial transport and military vehicles, and for protection of buildings and infrastructure. Constituent thermoplastics and metals have distinct advantages as protective materials, however metals on their own are heavy, hence hybrid materials offer option as lighter materials. This study focuses on the effect of surface treatments to improve adhesion between dissimilar materials such organic polymers with metal reinforcement materials. Surface energy was found to possess a direct relationship with the amount of polar groups on the surface of a modified polymer and free radicals on the metal surface. Higher surface energy correlates with superior interface adhesion. This work establishes the basis that polar groups and free radicals improve adhesion between polymeric (thermoplastics) and metallic surfaces.

INTRODUCTION

Thermoplastic composites are becoming more prevalent in automobile, aerospace, medical and electronic applications due to high-strength and low weight characteristics [1]. The growing demand for high performance thermoplastic-metal composites has been challenged by the problem of the lack of adhesion between fiber and matrix. Some of the adhesive mechanisms through which the surface treatments promote interfacial bonding include improvement of wettability, addition of chemical groups and variation of surface topography [2-8]. Previous research suggests that it is possible to improve the adhesive bonding between dissimilar materials across the interface [6-8].

This paper studies the effect of surface treatment to improve the adhesion of thermoplastic polymers to steel. Plasma treatment is used to provide reactive molecules (Si, H and C) on the surface of steel. Maleic anhydride (MA) is used to introduce carbonyl groups (–C=O) on polypropylene (PP) with a purpose to create reactive sites that promotes bonds between surfaces. Furthermore, this study analyzes the adhesion of steel to PP, soft and hard thermoplastic polyurethane (TPU) and polypropylene modified by maleic anhydride (PP-MA). The overall objective is to investigate mechanisms of bonding and finally enhance the bond at the interface between metal-polymer surfaces.

Materials & Methods

Materials: The thermoplastic polymers used were standard polypropylene (PP), Dow PM613 PP-MA, Merquinsa Pearlthane D11T75 and Pearlthane D11T85 TPU. The steel was a cold-rolled low carbon steel AISI/SAE 1018.

Contact Angle Test: Contact angle values were estimated by analyzing an image of a water droplet using a Reme Hart Goniometer (Model 100-00115) with a Sony CCD B/W digital camera module (model XCD-X700 with Dire-l 3.0 Software (9). For each material, five droplets of water on the surface were used to obtain the average of ten readings for each sample. A standard deviation less than 3 % was the higher limit to accept the value. Others parameters followed ASTM D5946 and ASTM D5725.

Lap Shear Strength Test: Lap shear strength tests were performed to analyze the effect of surface roughness, polymer type and metal surface treatment to the bond strength between metal and polymer. ASTM D3164M and D4896 were use to determine parameters and interpret results. ASTM D2093 and D2651 were used to prepare metal and polymer surfaces prior to the adhesion. The bond strength was calculated as the failure load divided by the fracture surface area. Six samples of each case were tested in tensile load with a Mechanical Testing System (MTS Systems Corp., Eden Prairie, MN, USA) under a displacement rate of 1.3 mm/s until failure. Steel specimens with optimized roughness were tested to bond with different polymers, PP, PP-MA, soft and hard TPU (10). Once the polymer with the highest bond strength was found, steel specimens with plasma treatment (Si-steel and C:H-steel) were tested to evaluate the metal surface modification.

Plasma Treatment on Steel Surface: Surface modification and coating was explored using a proprietary amorphous, hydrogenated carbon (a-C:H) coating vessel from Plasma Electronic, GmbH. The deposition method is Plasma Activated Chemical Vapor Deposition (PACVD). Under a controlled low atmosphere of reaction gases, the vessel induces a voltage bias of approximately 500 volts. The metal to be coated is put in contact with the cathode target, and uniform stable high energy plasma of reaction

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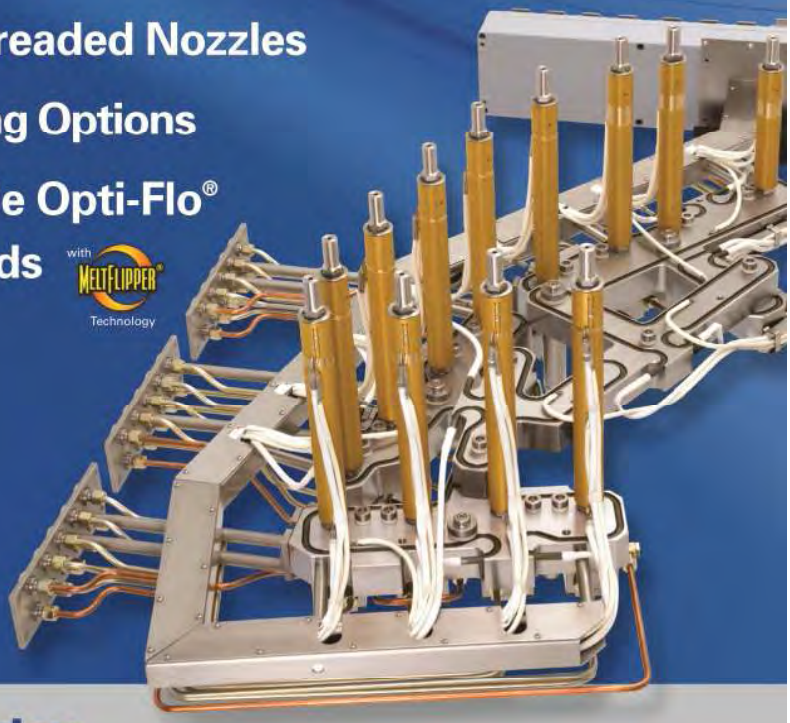

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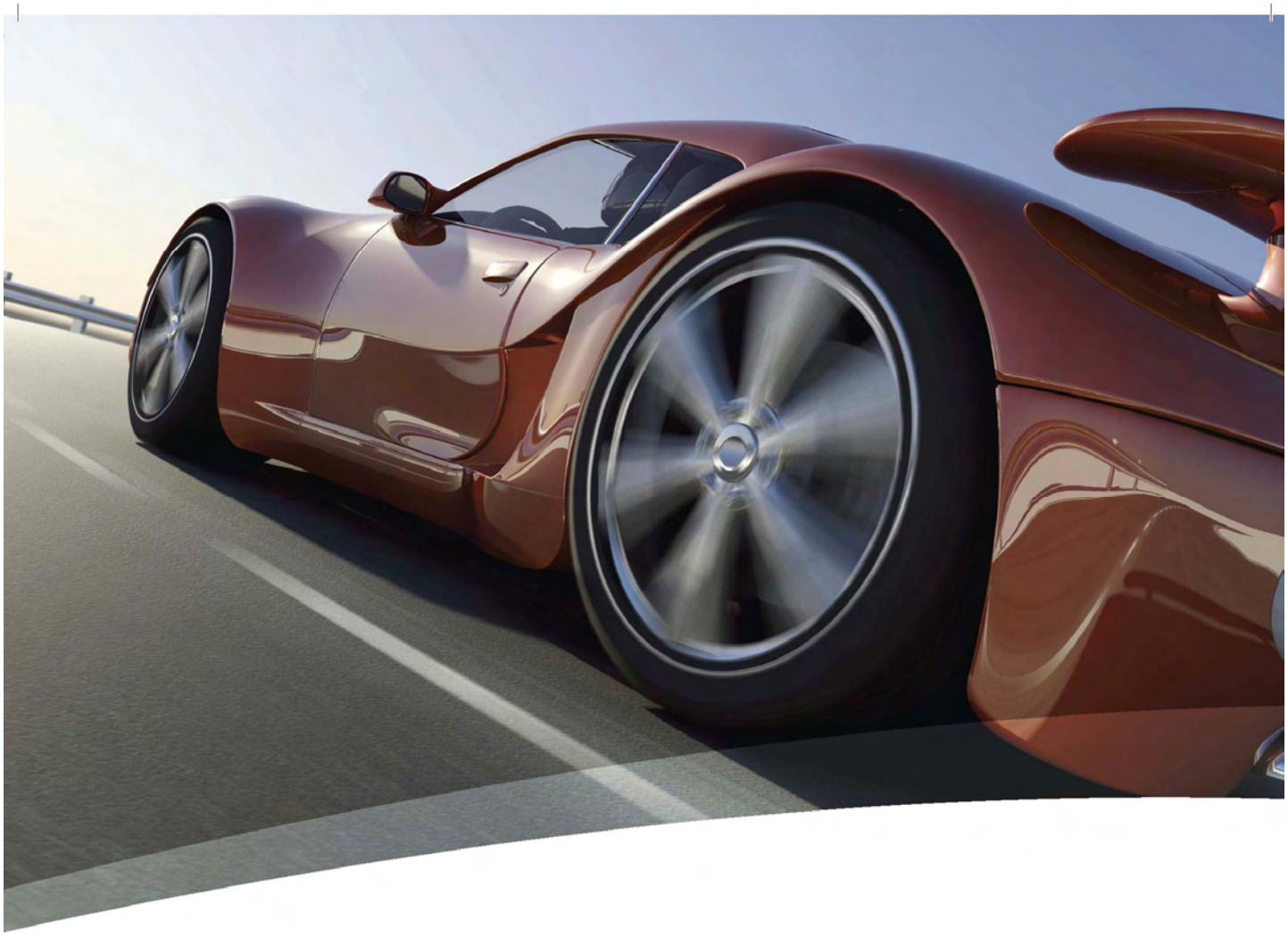

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Technical Paper

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elements is formed on the entire cathode surface. The temperature of the process is 200ºC; in consequence no thermal impact is expected on the material.

RESULTS AND DISCUSSION

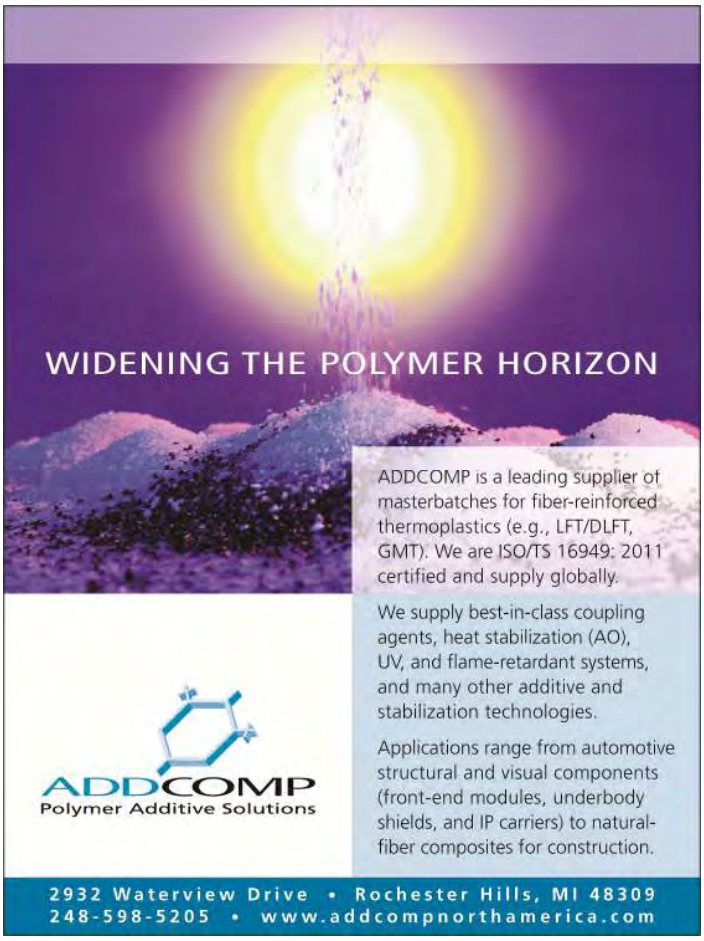
Molecular Characterization

Functional Polar Groups in Polymers: Fourier Transform Infrared Spectroscopy (FTIR) was used to analyze the composition of the thermoplastics used in the study. Because chemical bonds absorb infrared energy at specific frequencies (or wavelengths), specific functional groups of the polymer are determined by the spectral locations of their IR absorptions (peaks).

Figure 1 (left) compares the FTIR spectra of neat PP and PP-MA respectively. The spectra shows four absortion peaks at 2348, 1638, 997 and 675 cm-1, the first and second peaks correspond to C=O carbonyl functional group, third to the C-O stretch anhydride functional group, and last to C-H bend alkene functional group. These groups constitute the MA. The MA content in PP-MA was calculated by Equation (1), where A997 is the absorbance of the anhydride group at 997 cm-1, d is the thickness (mm) of the sample, and K is a constant (= 0.25) detected by calibratrion of the known MA content of PP-MA.

MA wt% = K (A997/d) = 0.25 (0.07/2) = 0.875 wt % (Eq. 1)

Figure 1 (right) compares the FTIR spectra for two types of TPU, i.e. soft TPU and hard TPU. The -NH amide functional group is observed at 3298, 1528 and 1504 cm-1; -C=O, carbonyl groups from ester are located at 1727 and 1698 cm-1, functional carbons of aromatic rings –C=C are found at the range of 1600-1475 cm-1 and the peak of isocyanate functional group –N=C=O is at 2341 cm-1 is All these peaks are active sites that are able to react with the steel surface due to the polarity and the double bonds. This explains the excellent adhesion of TPU to steel. The intensity of the –CH alkane peaks and –C=O carbonyl peaks at 2919-2848 and 1727-1698 cm-1 determine the amount of crystalline and amorphous regions in the polyurethane and generates the difference between soft TPU and hard TPU. For soft TPU, the higher content of amorphous regions correlates with the higher intensity of the peaks mentioned above.



Contact Angle & Surface Energy: Adhesion between surfaces is expected to proceed with the chemical attraction of specific sites. The contact angle was determined for different polymers and steel 'with' and 'without' coating treatment. Higher surface energy generates better adhesion to substrates with similar

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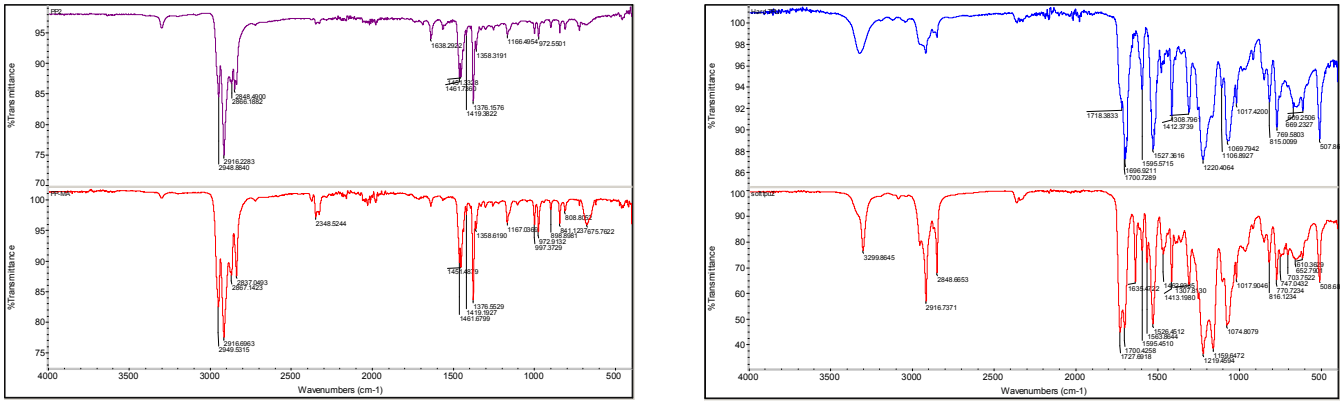

Figure 1. FTIR spectra of PP (left above); PP-MA (left below); hard TPU (right above) and soft TPU (right below)

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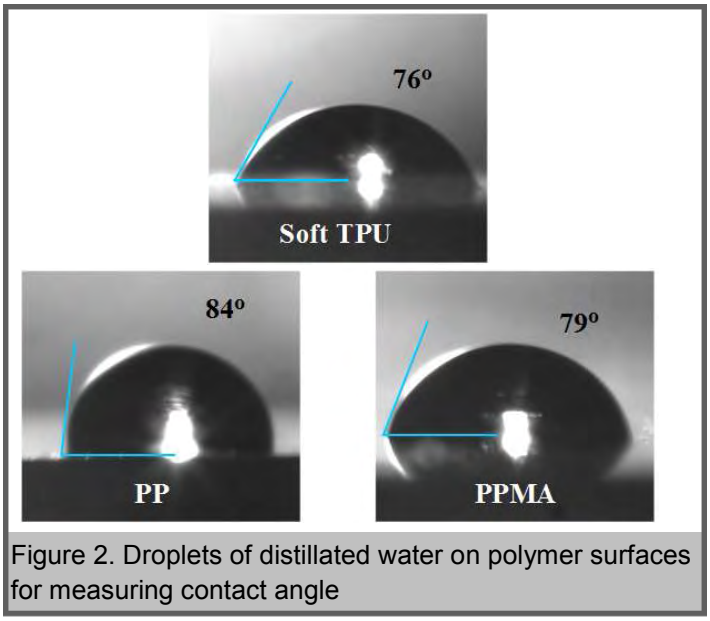

Figure 2. Droplets of distillated water on polymer surfaces for measuring contact angle

polarity. A contact angle equal to or greater than 80º signifies a hydrophobic surface. It is well known that polymers are hydrophobic and have low surface energies.

Polymer Surfaces: In general polymers have low surface energy with contact angles above 85º; a contact angle below this value is an indication that the polymer has been treated to improve adhesion. An angle close to 110º implies a hydrophobic behavior of the polymer, and an angle close to 70º is related to a hydrophilic polymer. Figure 2 shows typical optical measurements of contact angle for the polymers in the study. As predicted PP has high contact angle of 84º, followed by PPMA with 79º and soft TPU with 76º.
Figure 3 compares the results of surface energy and contact angle for PP, PP-MA and soft TPU. As expected PP has the lowest surface energy (35 dyne/cm) due to the saturated polymer chain without any polar groups to react. Functionalization of PP is achieved by maleic anhydride to create -CO= reactive polar groups, these polar groups increase wettability of the polymer and consequently adhesion with the metal substrate.

Figure 3 illustrates the correlation between contact angle and surface energy to the bond strength measurements between the different thermoplastic polymers and steel. Higher surface at the polymer reveals superior bond strength with steel, as measured by lap shear strength test. The value of surface energy has direct relationship with the amount of polar groups or reactive ions at the surface of the polymer; thus PP, which lacks of free radicals in its polymeric chain has the lowest surface energy. Soft TPU with –NH and –C=O functional groups and PP-MA with C=C,-C=O functional groups have similar surface energy close to 38 dyne/cm, which allows the polymer to attach to steel. A surface energy above 36 dyne/cm in polymers is an indication of good adhesion

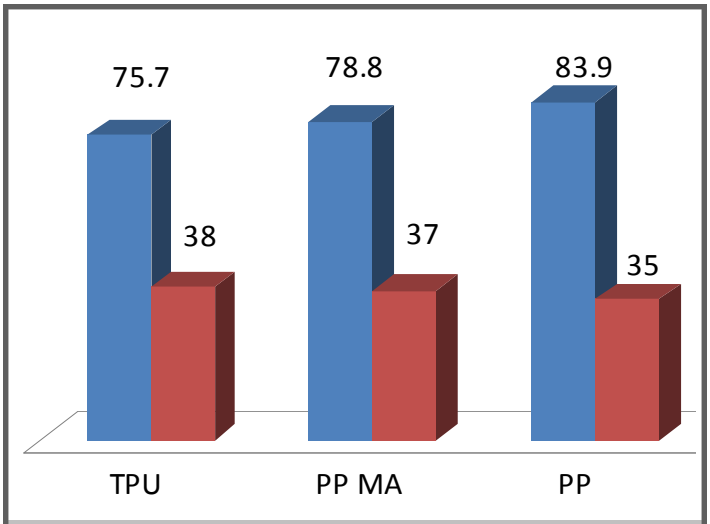

Figure 3. Contact angle and surface energy for different polymer types. Tall bars – Contact angle (degrees); Short bars – Surface energy (dyne/cm)

with fibers of different materials (i.e. carbon, glass, Kevlar).

Steel Coated and Uncoated: Usually, metals have high surface energy; however to increase wettability, surface treatment was employed to impart reactive site for bonding with polymeric materials. Figure 4 shows the contact angle for steel coated and uncoated. Comparing the contact angle of the uncoated steel to Si coated steel and a C:H coated steel, Si coating provides a surface to steel with lower value for a contact angle of 79º, however the difference between the three cases is almost insignificant (82º, 79º, 80º respectively), increasing the surface energy only by 6% as shown in Figure 4.

Lap Shear Strength: Bond strength of polymer-metal adhesion was determined by single lap shear test. Figure 5 compares the bond strength of steel to different thermoplastic polymers. PP-MA and TPU bond with similar strength to steel, which confirms the previous analysis of molecular characterization and wettability of these polymers. PP-MA exhibits bond strength of 3.18 MPa vs

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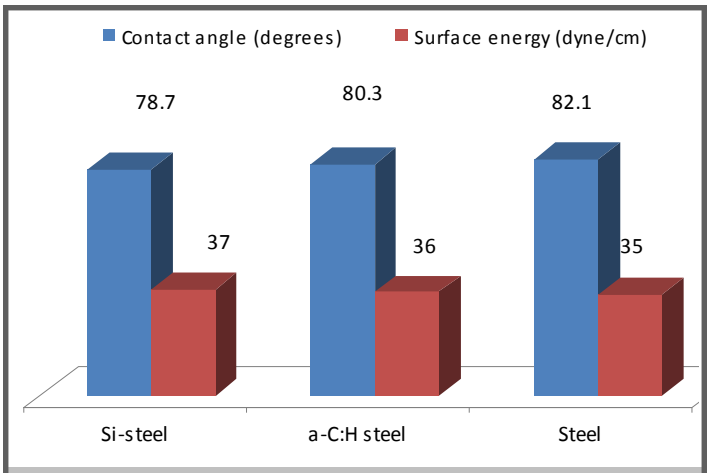

Figure 4. Contact angle and surface energy for plasma treated and non-treated steel

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3.25 MPa for soft TPU. PP-MA has close to the double the value on bond strength compared to neat PP (3.18 vs. 1.47 MPa).

PAPCVD was used to add specific molecules on the metal surface that can diffuse into the bulk polymer and create a stronger interface. This interface represents the elimination of distinct joining surfaces, and replaces it with a relatively smooth gradient from the metal to the polymer. Molecules of silicon, hydrogen and carbon interact with the surface of PP-MA. The surface of PP-MA offers active radicals of -C=O that interact with the molecules on the steel surface after the plasma treatment. Figure 4 showed the effect of plasma treatment on steel on the bond strength of PP-MA. The bond strength is not only a function of the roughness of the steel surface but also of the type of coating on the steel. Silicon coating promotes better adhesion, however hydrogenated coated (a-C:H-steel) decrease the bond strength with PP-MA.

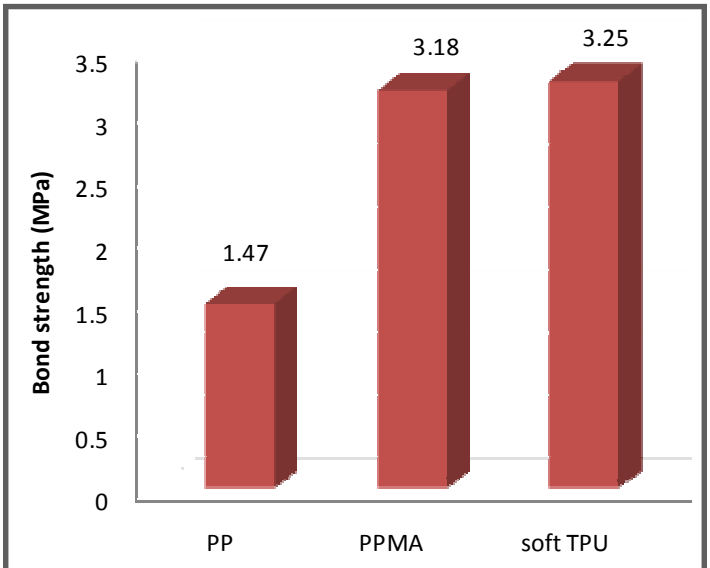

Figure 5. Effect of polymer type on the bond strength at the polymer-steel interface.

SUMMARY

Functionalization of polymers has been analyzed in this work. PP one of the most used polymers due to its low cost, good mechanical properties and easy processing can be modified with maleic anhydride to add polar functional groups and improve adhesion with steel. Thermoplastic polyurethane is also a good option to generate adhesion with metal surfaces due to the high content of polar groups that increases wettability of the polymer, even though the mechanical properties are lower. Adversely, epoxy with fullerenes failed in the purpose of increasing adhesion mainly due to the presence of surface voids during the curing process.

Silicon surface coating provides better adhesive properties between metal-to-polymer surfaces. Specifically, this technique appears to be an effective and efficient method to promote better adhesion between steel and PPMA. However, experiments showed no correlation between surface energy and bond strength for this type of surface treatment; in fact, for coated steel, wetting tension on the steel surface is not an indication of potentially better adhesion and it is possible that diffusivity is the mechanism of adhesion between coated steel and PPMA. A correlation between contact angle in the type of polymer and bond strength was found to be directly proportional, which indicates that polar groups on the polymer surface dominate the adhesion with steel and can be predicted by the value of contact angle. Also, for the polymers in the study, the effect of wettability dominates the ability to adhere on steel.

ACKNOWLEDGEMENT

Support provided by the Army Research Laboratory (ARL) and Department of Energy (DOE) Graduate Automotive Technology Education (GATE) is gratefully acknowledged.

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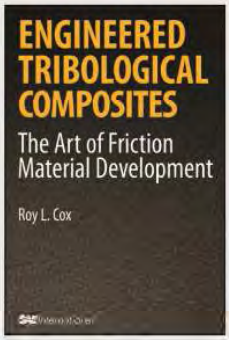

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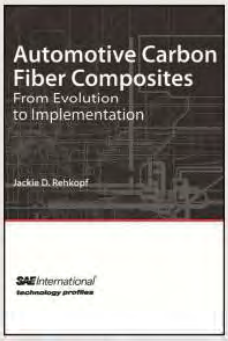

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SPE Automotive Division Directory

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