AUTOMOTIVE COMPOSITES CONFERENCE & EXHIBITION

Novi, MI • September 6-8, 2023

Presented by SPE Automotive and Composites Divisions

WORLD'S LEADING AUTOMOTIVE COMPOSITES FORUM

COMPOSITES THE KEY TO EV

AUTO & AIR MOBILITY

SUBURBAN COLLECTION SHOWPLACE

The Diamond Banquet & Conference Center at the Suburban Collection Showplace
46100 Grand River Ave. Novi, MI 48374 USA

DIAMOND CENTER

MITSUBISHI CHEMICAL GROUP

Composite Technology for Tomorrow's Automotive and Mobility designs

Lightweight | Durable |Environmentally Friendly

Scan code to contact us about our composite materials.

WELCOME ACCE2023!

COMPOSITES THE KEY TO EV

AUTO & AIR MOBILITY

On behalf of the Society of Plastics Engineers, the organizing committee would like to wish a warm welcome to ACCE 2023 to all attendees, authors, exhibitors, students, engineers and researchers!

Last year, we introduced the topic "Key to EV", mirroring the clear shift of the automotive industry to battery powered vehicles and the demand for safe, lightweight, cost-efficient and sustainable materials. With the success of last year's technical sessions, keynotes and a panel discussion, we decided to double down and even include another growing sector with a significant increase in EV applications – electric air mobility.

We also added more focus on another important field – sustainability! We dedicated a full session of keynotes and technical presentations on sustainable solutions and want to give the audience an insightful overview on one of the most critical stages of life cycle analysis – the end of vehicle life stage.

In 2023, we are again excited to welcome our friends from all over the US and the whole world to bring our composites community back together. We encourage you to connect and re-connect, meet and converse at the exhibits and our networking events and seize the opportunity to learn, share and network with the composites industry.

These interactions and discussions are essential activities and core motivation for our society and for all participants: engineers, students, academia, businesses and all professionals of the composites industry. The goal of this event is to keep the automotive sector evolving with new technologies that are enabled by composites and plastics.

We wish everyone a successful ACCE 2023!

Best regards,
Chris & David

CONFERENCE CO-CHAIR
Dr. Christoph Kuhn
Volkswagen Group of America
Christoph.Kuhn@vw.com

CONFERENCE CO-CHAIR
Dr. David Jack
Baylor University
david_jack@baylor.edu

TECHNICAL PROGRAM CO-CHAIR
Dr. Dana Gabriela Miloaga
Johns Manville
dana.miloaga@JM.com

TECHNICAL PROGRAM CO-CHAIR
Dr. Mehdi Tajvidi
The University of Maine
mehdi.tajvidi@maine.edu

EXECUTIVE COMMITTEE MEMBER
Dr. Sara Simon
Forward Engineering NA
simon@forward-engineering.com

2023 CONTRIBUTORS

ADDITIVE MANUFACTURING & 3D PRINTING (AM3D)

Trevor Fleck*
Baylor University
trevor_fleck@baylor.edu

Douglas Smith
Baylor University
douglas_e_smith@baylor.edu

ADVANCES IN THERMOPLASTIC COMPOSITES (TP)

Oleksandr Kravchenko*
Old Dominion University
okravche@odu.edu

Raghu Panduranga
North Carolina A&T University
raghupanduranga@gmail.com

Siavash Sattar
University of Minnesota Duluth
ssatt003@odu.edu

Keith Siopes
EMS-GRIVORY
keith.siopes@us.emsgrivory.com

ADVANCES IN THERMOSET COMPOSITES (TS)

Dustin Davis*
Norplex-Micarta
ddavis@norplex.com

Dan Dowdall
INEOS Composites
djdowdall@INEOS.com

Jeffrey Lonergan
Huntsman
jeffrey_lonergan@huntsman.com

BONDING, JOINING & FINISHING (BJF)

Diego Pedrazzoli*
Johns Manville
diego.pedrazzoli@jm.com

Michael Barker
Bostik
michael.barker@bostik.com

Hicham Ghossein
Endeavor Composites
hicham.ghossein@gmail.com

Enamul Haque
A2H Consulting
enamul.haque@a2hconsultinggroup.com

Daniel Pulipati
Baylor University
daniel_pulipati@baylor.edu

Bill Reed
Branson Emerson
billreed@emerson.com

Jared Stonecash
Michelman
JaredStonecash@michelman.com

CARBON COMPOSITES & REINFORCEMENTS (CCR)

Hendrik Mainka*
Volkswagen of America
hendrik.mainka@VW.com

Dale Brosius
IACMI
dbrosius@IACMI.org

Ginger Gardiner
CompositesWorld
ggardiner@CompositesWorld.com

Adam Halsband
Forward Engineering North America, LLC
halsband@forward-engineering.com

Brian Knouff
Oak Ridge National Laboratory
knouffbj@ornl.gov

Bhavesh Shah
General Motors
bhavesh.shah@gm.com

COMPOSITES IN ELECTRIC VEHICLES (EV)

Bhavesh Shah*
General Motors
bhavesh.shah@gm.com

Mohammadreza Eftekhari
Ford Motor Company
meftekha@ford.com

Enamul Haque
A2H Consulting
enamul.haque@a2hconsultinggroup.com

ENABLING TECHNOLOGIES (ET)

Victor Bravo*
Sheridan College
victor_brave2002@yahoo.com

Pruthul Kokkada
Baylor University
pruthul_kokkadaravin@baylor.edu

Joaquin Moran
Sheridan College
joaquin.moran@sheridancollege.ca

Antoine Rios
Madison Group
antoine@madisongroup.com

MODELING OF COMPOSITES (MC)

Pruthul Kokkada*
Baylor University
pruthul_kokkadaravin@baylor.edu

Arnaud Dereims
ESI Group
ads@esi-group.com

Dominik Dörr
Simutence GmbH
dominik.doerr@simutence.de

Sergey Kravchenko
University of British Columbia
sergey.kravchenko@composites.ubc.ca

SUSTAINABLE COMPOSITES (SC)

Eric Haiss*
IDI Composites International
ehaiss@idicomposites.com

Dustin Davis
Norplex-Micarta
ddavis@norplex.com

Marton Kardos
Volkswagen of America
marton.kardos@VW.com

Amanda Nummy
Hyundai America Technical Center, Inc.
anummy@HATCI.com

**Session Organizer*

PARTS COMPETITION CHAIR
Dr. Leonardo Simon
University of Waterloo
leonardo.simon@uwaterloo.ca

STUDENT POSTER COMPETITION CHAIR
Douglas Smith
Baylor University
douglas_e_smith@baylor.edu

PROGRAM TREASURER
Jitesh Desai
SPE Automotive Division
treasurer@speautomotive.com

SPONSORSHIP CHAIR
Teri Chouinard
Intuit Group
intuitgroup@gmail.com

PROGRAM ADMINISTRATOR
Kim Hoodin
SPE Automotive Division
accepapers@speautomotive.com

WEDNESDAY SEPTEMBER 6

SCHEDULE SUBJECT TO CHANGE

ALL TIMES USA EDT

7:30–8:00 **REGISTRATION / COFFEE / EXHIBITS OPEN**

800–8:15 **OPENING REMARKS AND AWARD PRESENTATIONS** Including Best Paper and Scholarship Awards (Opal/Garnet/Onyx)
Christoph Kuhn and David Jack, *2023 SPE ACCE Co-Chairs;*
Dana Miloaga and Mehdi Tajvidi, *2023 SPE ACCE Technical Program Co-chairs*

8:15-9:00 **KEYNOTE ADDRESS** (Opal/Garnet/Onyx)
What Does Disruptive Electrification of Transport Mean for Industrialization of Composites? Joe Summers, *Airborne UK*

9:00–10:00 **EXHIBITS OPEN / COFFEE BREAK**

	OPAL/GARNET/ONYX	EMERALD/AMETHYST	GOLD/COPPER/GRANITE	SILVER/BRONZE
	THERMOPLASTIC COMPOSITES	**SUSTAINABLE COMPOSITES**	**ADDITIVE MANUFACTURING & 3D PRINTING**	
1000–10:30	Development of a Novel Light Weight Reinforced Thermoplastic (LWRT) for Automotive Applications Richard Kim, *Hanwha Azdel*	Upcycling the Impossible: Recovered Glass Fiber for a Genuine Circular Economy David Morgan, *Carbon Rivers*	Investigation of Surface Characteristics on Additively Manufactured Composites Sung Jun Choi, *Purdue University*	
10:30–11:00	Green Composites from Hop Natural Fiber and Bioplastic Arturo Rodriguez Uribe *University of Guelph*	Designing for Sustainable Content and Performance in Phenolic Sheet Molding Compound Hugh MacDowell *Teijin Automotive Technologies*	Introduction of Continuous Fiber Thermoplastic Tapes and Laminates into 3D Printed Structures Jonathan Spiegel, *Polystrand, Avient Corporation*	

11:00–11:30 **JUDGING OF STUDENT POSTERS**

11:30–12:30 **NETWORKING LUNCHEON** - Student Presentations for SAE Auto Demonstrations

	THERMOPLASTIC COMPOSITES	**SUSTAINABLE COMPOSITES**	**ADDITIVE MANUFACTURING & 3D PRINTING**	**ENABLING TECHNOLOGIES**
12:30-1:00	The Lightweight Solution for Underbody Protection Panels of BEVs: Glass fiber-PP Organo-sheets Udo Steinhauer, *Profol*	Novel Cellulose Composites for Automotive Applications Marton Kardos *Volkswagen Group of America, Inc.*	Advancing the Use of Sandwiched Composites through Hybrid Manufacturing the Core Structures Savannah Rose, *Baylor University*	Simultaneous Estimation of In-Plane Permeability and Porosity in Fiber Reinforcement Anand Bora, *Moldex3D Northern America, Inc.*
1:00-1:30	Thermoplastic Structural Composites for Sustainable Weight Reduction of Automotive Components Chris Johnston, *Aerlyte*	Sustainable Polyolefin Composites for Today and Tomorrow Kevin George *GEON Performance Solutions*	Flexible Fusion 3D: Advancing Additive Molding Fabrication for Enhanced Mechanical Properties of FDM Alex Kravchenko, *Old Dominion Univ.*	Integration of NDT into the Manufacturing Process Chain of Functionalized UD-tape Components Aaditya Suratkar, *Fraunhofer ICT*
1:30–2:00	Restoration of Strength in Polyamide Woven Glass Fiber Organosheet After Impact Using Hot Pressing Mohammad Nazmus Saquib *Old Dominion University*	Elements of Sustainability for FRP Composites John Schweitzer *American Composites Manufacturers Association*		Enhancing Recycled Thermoplastic Composite Parts Using Recycled Composite Laminate Cutouts Garam Kim *Purdue University*

2:00–3:00 **EXHIBITS OPEN / COFFEE BREAK**

	THERMOPLASTIC COMPOSITES	**SUSTAINABLE COMPOSITES**		**ENABLING TECHNOLOGIES**
3:00–3:30	Use of Thermal Black as Filler in High Performance HDPE Films Mihaela Mihai *National Research Council of Canada*	Hybridized Coir/glass Fiber Reinforced Polypropylene Composites Sanjita Wasti *University of Tennessee-Knoxville*		Accelerating Sustainable Composites Manufacturing with Dielectric Sensors and Machine Learning Alec Redmann, *NETZSCH*
3:30–4:00	Continuous Fiber Reinforced Thermoplastic Tape Laying and Consolidation for Automotive Cycle Times Louis Kaptur, *Western University*	Use of Thermal Black in PLA Films for Industrial Applications Sajjad Saeidlou *National Research Council of Canada*		High Performance, Bio-based & Sustainable Sandwich Core Materials for Automotive & Air Mobility Russell Elkin, *Baltek Inc.*
4:00–4:30	ATSP Innovations Estherm Oligomer for Enhancing Properties of Certain Thermoplastics Fred Deans, *Allied Composite*	Technologies, LLC Westlake Epoxy's Roadmap to Reduce Carbon Footprint Kameswara Nara, *Westlake Epoxy*		Smart SMC Cutting and Stacking Solutions in Conjunction with Advanced SMC Production Lines Raimond Grimm, *Dieffenbacher*

4:15-5:15 **KEYNOTE ADDRESS** (Opal/Garnet/Onyx)
A Role for Composites in GM's Vision for Simulation-driven Design and Sustainable Material Impact
Jason Coryell, *General Motors*

5:15-6:30 **COCKTAIL RECEPTION**

6:30 **CONFERENCE ADJOURNS FOR THE DAY**

THURSDAY SEPTEMBER 7

ALL TIMES USA EDT

7:30–8:00 REGISTRATION / COFFEE / EXHIBITS OPEN

8:00 **WELCOMING REMARKS** (Opal/Garnet/Onyx)
Christoph Kuhn and David Jack, *2023 SPE ACCE Co-Chairs*

8:00–9:00 **KEYNOTE ADDRESS** (Opal/Garnet/Onyx)
An Overview of Transportation of Transportation Trends and Related Opportunities
Gregory Peterson, *ASX (Airspace Experience Technologies)*

9:00–10:00 EXHIBITS OPEN / COFFEE BREAK

	OPAL/GARNET/ONYX	EMERALD/AMETHYST	GOLD/COPPER/GRANITE	SILVER/BRONZE
	THERMOSET COMPOSITES		**MODELING OF COMPOSITES**	**COMPOSITES IN ELECTRIC VEHICLES**
1000–10:30	Effect of Starch-based Hybrid Additive on Mechanical & Thermal Properties of Epoxy-based Composites Lynsey Baxter, *MITO Material Solutions*		Predicting Fatigue Responses for Polymeric Materials Satvir Aashat *General Motors*	The Interdependency of Design, Materials, and Manufacturing to Optimize a Composite Battery Solution Gregory Poterala *Solvay*
10:30–11:00	Snap Cure Resin for High Rate FST Rated Automotive Composites Henry Sodano *Trimer Technologies*		Fatigue Crack Propagation of Carbon Fiber Reinforced Composite Laminates Arief Yudhanto *Baylor University*	Lightweight Hybrid Composite Design for E/V Battery Pack Case to Enhance Safety and Productivity Jong Hyun Kim *Hanwha Advanced Materials*
11:00–11:30			Opportunities and Challenges of Composites Forming Simulation for Digital Product Development Dominik Dörr *Simutence GmbH*	Flame Retardant Intumescent Sheet Molding Compound for Electric Vehicle Battery Cover Application Steven Prascius *Teijin Automotive Technology*

11:30-12:00 **JUDGING OF STUDENT POSTERS**

12:00–1:00 **NETWORKING LUNCHEON** - Student Presentations for SAE Auto Demonstrations

	THERMOSET COMPOSITES	**CARBON COMPOSITES AND REINFORCEMENTS**	**MODELING OF COMPOSITES**	**COMPOSITES IN ELECTRIC VEHICLES**
1:00-1:30	Metal Organic Thickeners for Styrene-Free Resins in Sheet Molding Compound Eric Martin *Fraunhofer Innovation Platform for Composites Research*	Carbon Fiber from Corn-stover-derived Lignin: Effect of Molecular Weight on Processing & Properties Sagar Kanhere, *Center for Advanced Fibers and Films, Department of Chemical Engineering-Clemson University*	Press Forming of E-glass Fabric Reinforced Polypropylene: A Numerical Study Chandra Kishore Reddy Emani *University of Michigan - Dearborn*	Development and Validation of an EMI Enhanced SMC Compound for BEV Applications Adam Halsband *Forward Engineering North America*
1:30–2:00	Next Generation Polyolefin Thermosets for High Volume HP-RTM Mobility Applications Jeffery Valentage *Materia Inc.*	Extrusion Deposition/Compression Molding of Hybrid Carbon/Glass Fiber Thermoplastic Oil Pans Brian Knouff, *Oak Ridge National Laboratory*	Simulating the Effect of Bead Microstructure on Interlayer Adhesion in AM Extrusion-Deposition Douglas Smith, *Baylor University*	Material Selection for Automotive Fire-resistant Applications Ian Swentek *Westlake Epoxy*

2:00–3:00 EXHIBITS OPEN / COFFEE BREAK

SPECIAL TOPIC (Opal/Garnet/Onyx)
SUSTAINABILITY AND VEHICLE END OF LIFE

3:00–3:45 **Circularity for End of Life Vehicles**
Kari Bliss, *PADNOS*

3:45–4:30 **Recycling Plastics from End-of-Life Vehicles: The Final Frontier?**
David Wagger, *Institute of Scrap Recycling Industries (ISRI)*

4:45–5:45 **PANEL DISCUSSION** (Opal/Garnet/Onyx)
SUSTAINABILITY AND END OF VEHICLE LIFE

MODERATORS: Christoph Kuhn, *Volkswagen of America, Inc.*; Sara Simon, *Forward Engineering North America*
PANELISTS: Eric Walker, *Honda*; Kari Bliss, *PADNOS*; David Wagger, *ISRI*; Mehdi Tajvidi, *University of Maine*; Amar Mohanty, *University of Guelph*, Dan Dowdall, *INEOS*

5:45-7:00 **COCKTAIL RECEPTION**

7:00 CONFERENCE ADJOURNS FOR THE DAY

FRIDAY SEPTEMBER 8

ALL TIMES USA EDT

7:30–8:00 **REGISTRATION / COFFEE / EXHIBITS OPEN**

8:00–8:45 **KEYNOTE ADDRESS** (Opal/Garnet/Onyx)
We Don't Just Open Doors, We Lightweight Them: The Journey of Ultra-lightweight Carbon Fiber Reinforced Thermoplastic Composite Door Assembly
Ryan Hahnlen, *Honda*, and Srikanth Pilla, *University of Delaware*

8:45–9:00 **AWARD PRESENTATIONS** (Opal/Garnet/Onyx)
Student Poster Competition and Parts Competition Award Presentations
Douglas Smith, *2023 ACCE Student Poster Competition Co-Chair*,
Keith Nagara, *Dassault Systemes, Student Poster Competition Sponsor;*
Leonardo Simon, *2023 ACCE Parts Competition Chair*

9:00–10:00 **EXHIBITS OPEN / COFFEE BREAK**

	OPAL/GARNET/ONYX	EMERALD/AMETHYST	GOLD/COPPER/GRANITE
	2023 SPECIAL EDITION: PARTNERSHIPS ADVANCING COMPOSITES IN AUTOMOTIVE APPLICATIONS: HONDA NORTH AMERICA - CLEMSON UNIVERSITY	**CARBON COMPOSITES AND REINFORCEMENTS**	**BONDING, JOINING & FINISHING**
10:00–10:30	Design Development of a Lightweight Carbon Fiber Reinforced Thermoplastic Composite Automotive Door Amit Deshpande *Center for Composite Materials at University of Delaware*	Automated Foreign Object Detection for Composite Laminates Using High-Resolution Ultrasound Testing Rifat Ara Nargis *Baylor University*	Ultrasonic Welding Optimization of Continuous Carbon Fiber Thermoplastic Reinforced Composite Plies Harry Lee *Purdue University*
10:30–11:00	Performance Evaluation of World's First Thermoplastic Composite Door via Finite Element Analysis Gang Li *Clemson University*	Agility and Accuracy: Phased Array vs Single-Element Ultrasonic Testing in the Characterization of Barely Visible Impact Damage in CFRP Laminates Rachel Van Lear *Baylor University*	EVO PT®: The Self-Tapping Evolution in Clamp Load Generation for Highly Engineered Plastics Thiago Kalife *EJOT-ATF*
11:00-11:30	Digital Lifecycle : Rethinking Auto Product Development with Thermoplastic Composites Sai Adytia Pradeep *Clemson Composites Center*	Crack Growth Monitoring and Fatigue Analysis for CFRPs using Ultrasonic Inspection Khaled Matalgah *Baylor University*	Influence of Waterjet Cut Quality for Fabrication of Test Specimen on Mechanical Testing Results Jacob Montrose *Purdue University*
11:30–12:00	Advanced Manufacturing for Lightweight Continuous Carbon Fiber Thermoplastic Composite Door Assembly Pal Swaminathan *Envalior*		

12:00-12:15 **CLOSING REMARKS** (Opal/Garnet/Onyx)
Christoph Kuhn and David Jack, *2023 SPE ACCE Co-Chairs*

12:15 **CONFERENCE ADJOURNS FOR THE YEAR**

2023 SPONSORS

AUTOMOTIVE COMPOSITES CONFERENCE & EXHIBITION

Novi, MI • September 6-8, 2023

Presented by SPE Automotive and Composites Divisions

WORLD'S LEADING AUTOMOTIVE COMPOSITES FORUM

FEATURED SPONSOR & EXHIBITOR

MP Molding Products

STUDENT POSTER COMPETITION SPONSOR & EXHIBITOR

DASSAULT SYSTEMES

RECEPTION SPONSOR

The Institute for iacmi Advanced Composites Manufacturing Innovation — THE COMPOSITES INSTITUTE

LUNCH SPONSOR

MITSUBISHI CHEMICAL GROUP

COFFEE BREAK SPONSOR

Langzauner PERFECT

PREMIER PLUS SPONSORS & EXHIBITORS

INEOS Composites

Valeo — Automotive technology, naturally

PREMIER SPONSORS & EXHIBITORS

AOC Trusted Solutions

ASCEND PERFORMANCE MATERIALS

BASF We create chemistry

BYK Additives & Instruments

BOSTIK

FORWARD ENGINEERING

KATCON GLOBAL

Westlake Epoxy

ASSOCIATE SPONSORS & EXHIBITORS

CORE MATERIALS

A&P Technology

ATF

AVIENT

Baylor PROTOLAB

Baylor MTACC

COMPOSITES ONE

Applus DatapointLabs

DIEFFENBACHER

FAGOR ARRASATE

Western — in cooperation with Fraunhofer

HUBER ENGINEERED MATERIALS

IDI Composites International — idicomposites.com

Johns Manville

Langzauner PERFECT

MICHELMAN

OMYA

plenco — PLASTICS ENGINEERING COMPANY

Rassini

Etablissements Gallois S.A

SP2 Carbon

Schmidt & Heinzmann

tfp

TANGHO

TRELLEBORG

VECTORPLY

ZOLTEK — Toray Group

TABLE TOP SPONSORS & EXHIBITORS

Celanese — The chemistry inside innovation™

DASSAULT SYSTEMES

The Institute for iacmi Advanced Composites Manufacturing Innovation — THE COMPOSITES INSTITUTE

mila

trimer

ADVERTISING SPONSOR

DSCCONSUMABLES incorporated — *High quality lab ready dsc sample pans*

MEDIA / ASSOCIATION SPONSORS

ACMA

AUTOMOTIVE ENGINEERING

AM ADDITIVE MANUFACTURING

AUTONOMOUS

CW CompositesWorld

eVTOL INSIGHTS.COM

GARDNER Business Media, Inc.

Plastics Business

PLASTICS DECORATING

PLASTICS ENGINEERING

Plastics News

PT Plastics Technology

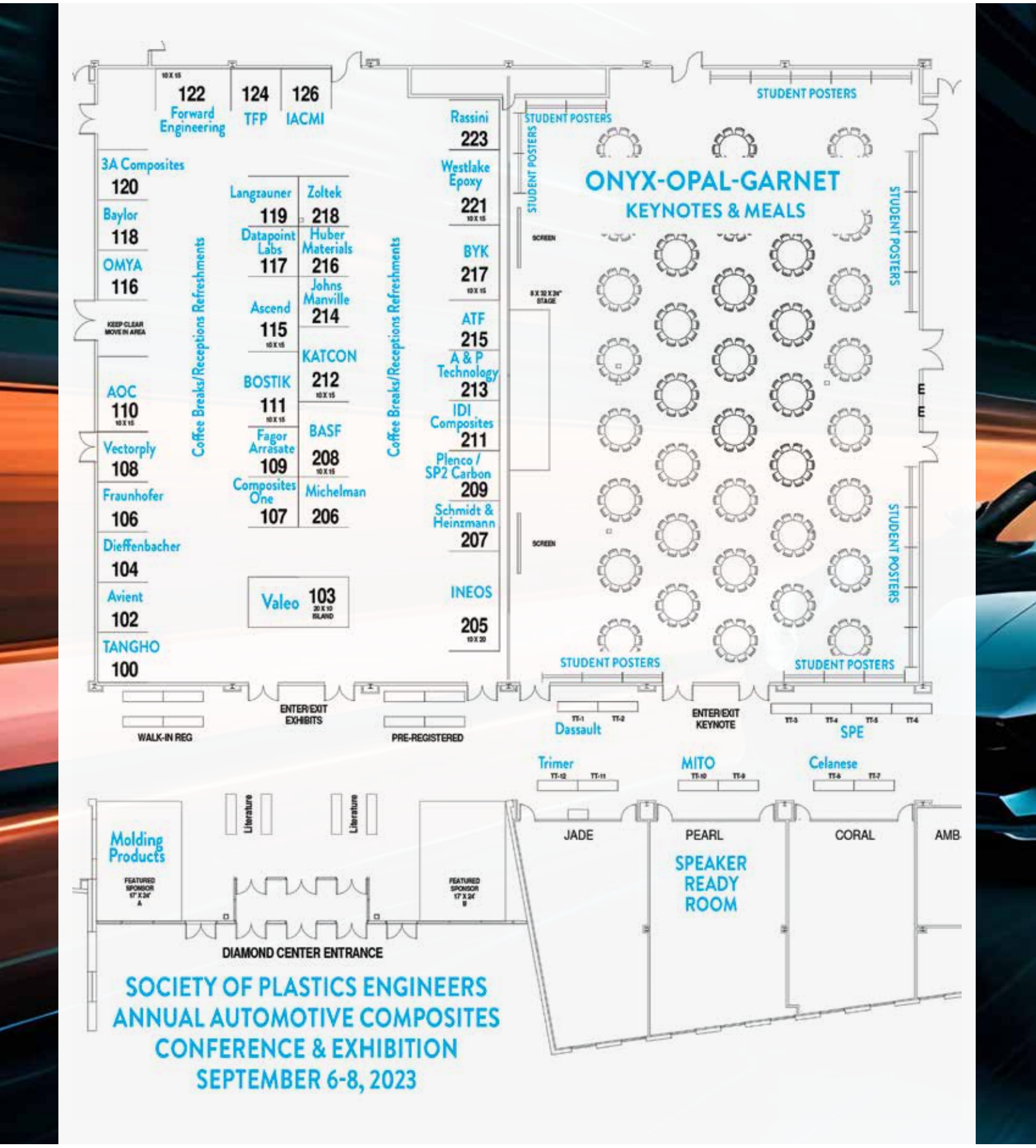
SAE INTERNATIONAL

ENGINEERING

Urethanes TECHNOLOGY

WARDSAUTO.COM

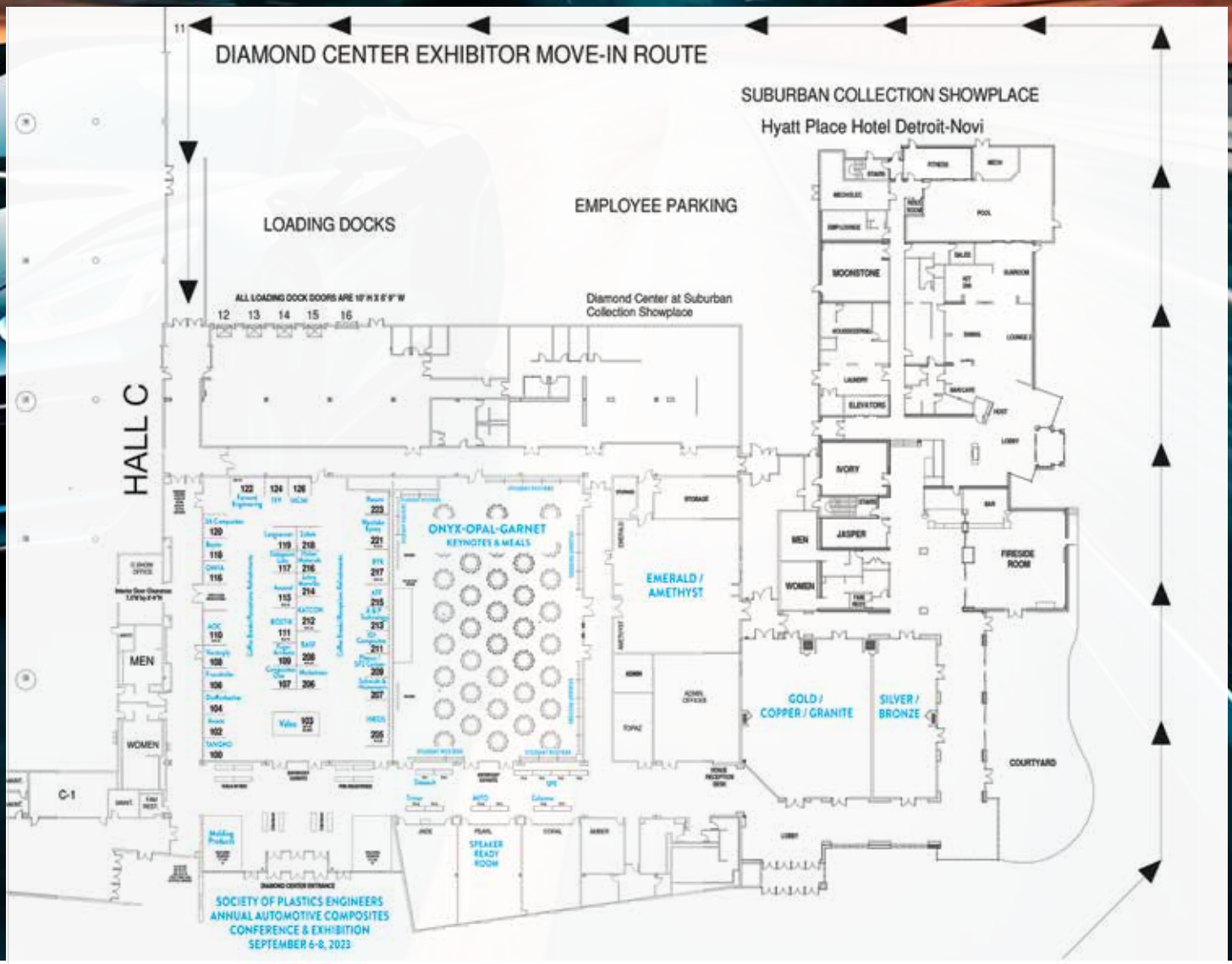
2023 EXHIBITOR LAYOUT



2023 EXHIBITORS ALPHABETICALLY

3A Composites	120	Dieffenbacher	104	Molding Products	Featured Sponsor A
A & P Technology	213	Fagor Arrasate	109	Omya	116
AOC	110	Forward Engineering	122	Plenco	209
Ascend Performance Materials	115	Western University/Fraunhofer	106	Rassini	223
ATF, Inc.	215	Huber Engineering Materials	216	SP2 Carbon	209
Avient	102	IACMI	126	Schmidt & Heinzmann	207
BASF	208	IDI Composites	211	Tangho	100
Baylor University	118	INEOS Composites	205	Technical Fibre Products Ltd	124
BOSTIK	111	KATCON Advanced Materials	212	Trimer Technologies	TT-12
BYK	217	Johns Manville	214	Valeo	103
Composites One	107	Langzauner GmbH	119	Vectorply Corporation	108
Dassault Systèmes	TT-1	Michelman	206	Westlake Epoxy	221
DataPoint Labs	117	MITO Material Solutions	TT-10	Zoltek	218
				SPE	TT-3-6

2023 FACILITY LAYOUT



2023 ACCE PART COMPETITION

This year's ACCE Part Competition is judged by a panel of automotive composites industry experts, from industry and academia, who have studied the nominations in advance of the event and will review the parts onsite. They will vote for the most innovative applications in each of 4 categories: Materials Innovation Protoype Part, Materials Innovation Production Part, Process Innovation Prototype Part, and Process Innovation Production Part.

Nominations are judged on the impact and trendsetting nature of the application, including materials of construction, processing method, assembly methods, and other enabling technologies that made the application possible. Nominations emphasize the benefits of design, weight and cost reduction, functional integration, and improved performance.

A fifth category, the People's Choice award, is selected by the popular vote of conference attendees. Here are the nominations:

PROCESS INNOVATION
HEXACORE™ CLASS A BODY PANEL PROCESS WITH IMC

Nominated by:
Teijin Automotive Technologies

PROCESS INNOVATION
ULTRA-LIGHTWEIGHT CARBON FIBER REINFORCED THERMOPLASTIC COMPOSITE DOOR ASSEMBLY

Nominated by:
Clemson Composites Center at Clemson University and Center for Composite Materials at University of Delaware

PROCESS INNOVATION
COMPOSITE OIL PAN FABRICATED WITH EXTRUSION DEPOSITION/ COMPRESSION MOLDING

Nominated by:
Oak Ridge National Laboratory

MATERIALS INNOVATION
THERMOPLASTIC COMPOSITE SANDWICH PANEL FOR TRUCK BED

Nominated by: Johns Manville

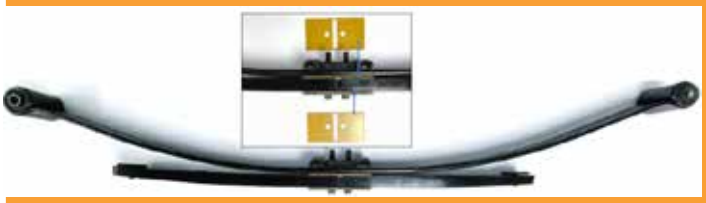
COMPETITION

MATERIALS INNOVATION
BATTERY CASINGS

Nominated by:
Valeo Thermal Systems

MATERIALS INNOVATION
COMPOSITE LINER FOR LEAF SPRINGS

Nominated by: Rassini International



MATERIALS INNOVATION
ORGANOSHEET BUMPER BEAM

Nominated by: Valeo Thermal Systems

MATERIALS INNOVATION
RECYCLED PAPER AND RECYCLED POLYPROPYLENE INTERIOR TRIM

Nominated by:
Volkswagen Group of America, Inc.z

MATERIALS INNOVATION
TACOMA ISODYNAMIC PERFORMANCE SEATS SEATBACK AND SEAT CUSHION FRAMES

Nominated by: BASF

START YOUR FREE SUBSCRIPTION

If it's happening in plastics, you'll hear about it in PT!

Scan here to sign-up today

A property of GARDNER Business Media

PTOnline.com

SPE® ANNOUNCES WINNERS OF ACCE & DR. JACKIE REHKOPF SCHOLARSHIPS

TThe organizing committee for the SPE Automotive Composites Conference & Exhibition (ACCE) is honoring winners of the **SPE ACCE Scholarships** and **Dr. Jackie Rehkopf Scholarships** at this year's event. The SPE ACCE Scholarships are sponsored by the SPE Automotive and SPE Composites Divisions. The Dr. Jackie Rehkopf Scholarships are sponsored by the SPE Automotive and Composites Divisions and generous donations of friends and family to honor the memory of the late long-time SPE ACCE committee member, SPE Automotive Division board member, and automotive composites researcher. Both scholarship programs are administered as part of the SPE Foundation.

The ACCE scholarships ($2,000 USD each) are awarded to students pursuing advanced studies in a composites related field. The three winners of the ACCE Scholarships are: **Amit Makarand Deshpande,** a graduate student pursuing a PhD in Mechanical Engineering at the Center for Composite Materials at the University of Delaware; **Md Nayeem Hasan Kashem,** a graduate student pursuing a PhD In Chemical Engineering at Texas Tech University; and **Suyash Oka,** a graduate student pursuing a PhD in Chemical Engineering at Texas A&M University.

Additional ACCE scholarships ($1,000 USD each) are being awarded to **Orville Tackett,** a sophomore majoring in Plastics Engineering and minoring in CAD and Electromechanical Engineering at Shawnee State University; and **Youyi Zhou,** a student majoring in Composite Materials Engineering and Minoring in Mathematics, Chemistry and Polymer Chemistry.

The two winners of the 2023 Dr. Jackie Rehkoph Scholarships ($2,500 USD each) are **Amy Kurr,** a PhD candidate pursuing a doctoral degree in Energy Science and Engineering from the University of Tennessee's Bredesen Center; and **Rachel Van Lear,** a PhD candidate pursuing a doctoral degree in Mechanical Engineering at Baylor University.

AMIT DESHPANDE is a PhD student at the Center for Composite Materials at University of Delaware, working to enhance the use of sustainable and lightweight composites technologies for automotive applications. His research is focused on advanced composites manufacturing processes, and development of digital life cycles for composite manufacturing processes that capture the process-structure-property relationships. Amit holds a master's degree in automotive engineering from Clemson University International Center for Automotive Research (CUICAR) with a focus on structural design, NVH, and advanced manufacturing. His efforts have contributed towards the successful development and demonstration of the world's first thermoplastic composite door for production vehicles.

MD NAYEEM HASAN KASHEM is a 4th-year Ph.D. student in the Chemical Engineering department at Texas Tech University (TTU). With an MSc from TTU in 2021 and a BSc from Bangladesh University of Engineering & Technology in 2017, both majoring in Chemical Engineering, he has a strong academic background in this field. His PhD research, focused on developing polymeric composite materials for nano- and micro-film fabrication and manufacturing of soft magnetic robots. Currently, he serves as the President of TTU's student chapter of SPE. He is passionate about continuing his research in this field and aspires to make significant contributions.

SUYASH OKA received his Bachelor of Technology in Dyestuff and Organic Chemistry Technology from the Institute of Chemical Technology (ICT), Mumbai, India, and joined Texas A&M University's Chemical Engineering Doctoral Program in 2019. He is working with Dr. Jodie Lutkenhaus, and his research focuses on developing mechanically strong and fast-charging structural batteries for low-temperature applications using organic redox active polymers. Five peer-reviewed journal articles, one of them as a first author in ACS *Applied Materials & Interfaces, another first-author article on its way, and multiple national conference presentations* has been his contribution so far. He worked as a Battery Cell Engineering Process Development intern with Tesla in summer 2022, and as a Battery Cell Engineering intern with Apple in summer 2023. He looks forward to focusing on learning and making a tangible difference towards composites in sustainable energy.

AWARDS

ORVILLE TACKETT
is a sophomore of Shawnee State University, majoring in Plastics Engineering, minoring in CAD and Electromechanical Engineering. Born and raised in Southern Ohio, Orville enjoys the outdoors, and spending time with loved ones. Being a first-generation student, his passion for engineering developed through the continued support and exploration provided by his parents and family. Taking pride in your work and knowing the value of teamwork are core values of his, and ensure a bright future. Once obtaining his degree, Orville hopes to further the engineering community through hard work and dedication in his chosen field.

YOUYI ZHOU
is an international transfer student from Guizhou, China. His professional goal is to successfully enter a top university's Ph.D. program, and his career goal is to be a professor in the United States. He likes materials science and is willing to 'run for it' through his whole life. He is interested in aerospace materials, composite materials, polymer materials, etc. Currently, he is working as an undergraduate researcher in the Purdue University SURF program. He is doing research on air purification with photocatalysis and acoustic filtering under Dr. David Warsinger. He has worked as a research assistant with his advisor Dr. Beckry from last summer break to now for composite material impact research and worked as a research assistant with Chemistry department professor Dr. Kopitzke last semester. He is very interested in the materials science and polymer sciences fields.

AMY KURR
is a polymer engineer with three years of experience as an electromechanical design engineer for Schneider Electric where she served as a technical product owner for electrical protective devices (e.g., shunt trips, miniature circuit breakers, electrical cables). She holds a bachelor's degree in Materials Science and Engineering from Iowa State University and a master's degree in Macromolecular Science and Engineering from Case Western Reserve University. Ms. Kurr completed her Spanish Business Certificate from the University of Wisconsin – Madison. She is currently pursuing a Ph.D. in Energy Science and Engineering from the University of Tennessee's Bredesen Center. In her free time, Ms. Kurr sits on the Standard Technical Panel for Underwriters Laboratories UL-746 (polymer materials) and serves as a professional development facilitator for Tau Beta Pi's – The Engineering Honor Society – Engineering Futures Program and the National Science Foundation-funded Cyber Ambassadors Program.

RACHEL VAN LEAR graduated with a Bachelor's in Mechanical Engineering in 2022 at Baylor University. She has additionally participated in four internships at Lockheed Martin's Missile and Fire Control, with experience ranging from systems to lethality engineering within the company. Continuing her education at Baylor University, she is now pursuing her PhD in mechanical engineering in hopes of graduating in 2026. Her research is in the area of ultrasonic testing and materials characterization of carbon fiber laminates. Currently she is working towards increasing the accuracy, agility, and automation of ultrasonic testing detection and quantification of damage within carbon fiber laminates.

The **SPE ACCE SCHOLARSHIP COMMITTEE** was led by **Dr. Alper Kiziltas,** Amazon Advanced Materials, and included **Dr. Leonardo Simon,** University of Waterloo; **Dr. Christoph Kuhn,** Volkswagen Group of America; **Dr. Oleksandr Kravenchenko,** Old Dominion University; **Dr. John Gillespie, Jr.,** University of Delaware; **Dr. Akshay Trivedi,** General Motors Co.; **Dr. Zeynep Iyigundogdu,** Adana Alparslan Turkes Science and Technology University; **Drew Geda,** Hyundai-Kia America Technical Center; **Chuck Jarrett,** The Materials Group; and **Keith Siopes,** EMS-CHEMIE North America; and **Dr. Prasad Soman,** Amazon Lab126.

AOC
Trusted Solutions

Solutions for Stronger, Lighter Technology

AOC technologies have been making strong, safe, and durable composite automotive parts for decades. Today's advanced technologies offer the positive attributes of conventional composite materials, with the added benefit of lower weight. This desirable combination helps manufacturers meet fuel efficiency and emission targets.

Composites' Competitive Edge

- Proven Polymer Technology
- Class "A" Surface
- Lightweight (Comparable to Aluminum)
- Excellent Impact Resistance
- Improved Fuel Efficiency
- Designed for Durability

aocresins.com | @AOCresins

"2024 Chevrolet Corvette E-Ray" photo by Chevrolet Pressroom is licensed under CC 3.0.

Atryl
CLOSED MOLD RESINS

KATCON | 30 years
The Vision of a Clear Sky

Come visit us at

Booth 212

www.katcon.com

THE NEXT GENERATION OF AUTOMOTIVE COMPOSITES ENGINEERS

/ SPE ACCE ATTENDEES ARE ENCOURAGED TO VIEW THE STUDENT POSTERS IN THE KEYNOTE/LUNCH AREA

/ STUDENT PROGRAM AND COMPETITION JUDGING

The student poster session is an annual event at the ACCE where students from U.S. and international universities present state-of-the art work related to plastic composite materials and manufacturing technologies relevant to automotive applications. Please join us in welcoming the students and take a look at their hard work, which will be on display in the keynote area and where lunch is served. This provides the students with an excellent opportunity to meet members of the automotive composites community and ask them what it's like to work as an engineer or scientist in this field. It also provides OEMs and their suppliers with the opportunity to meet the next generation of automotive composites engineers and scientists and potentially to hire them.

Judges made up of media, industry experts, ACCE attendees, and SPE board members. Students of winning posters, judged to be in the Top 3 in graduate and undergraduate categories, will win scholarships and will be awarded plaques. The awards presentation will take place during a formal recognition ceremony on Friday, September 8th from 8:30 to 9 am in the Keynote Area (Opal/Garnet/Onyx).

Students and their posters will be ranked according to the following criteria:

- 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 is supported by information presented

Since 2008, the SPE ACCE poster competition has been organized annually by **Dr. Uday Vaidya,** SPE Composites Division board member and education chair, as well as professor of Mechanical, Aerospace and Biomedical Engineering, University of Tennessee - Knoxville, University of Tennessee/Oak Ridge National Laboratory Governor's chair in Advanced Composites Manufacturing, and chief technology officer with the Institute for Advanced Composites Manufacturing Innovation (IACMI). This year, **Dr. Douglas E. Smith,** professor of Mechanical Engineering at Baylor University, is organizing the competition after co-chairing with Dr. Vaidya for more than 5 years.

COMPETITION

Thank you Dassault Systèmes for Sponsoring the SPE ACCE 2023 Student Poster Competition

DASSAULT SYSTEMES | The **3D**EXPERIENCE® Company

VIRTUAL WORLDS EXTEND AND IMPROVE THE REAL WORLD

Dassault Systèmes, the **3D**EXPERIENCE® Company, provides business and people with virtual universes to imagine sustainable innovations for today and tomorrow.
For more information, visit **www.3ds.com**

DASSAULT SYSTEMES | The **3D**EXPERIENCE® Company

2023 ABSTRACTS

SCHEDULED PRESENTATIONS, SUBJECT TO CHANGE

ADDITIVE MANUFACTURING & 3D PRINTING

Flexible Fusion 3D: Advancing Additive Molding Fabrication for Enhanced Mechanical Properties of FDM

Oleksandr Kravchenko
Professor, Department of Mechanical and Aerospace Engineering
Old Dominion University

The advent of Fused Deposition Modeling (FDM) has revolutionized manufacturing, offering reduced prototyping time and innovative design solutions. For structural applications, FDM parts often require the use of Fiber-Reinforced Polymers (FRPs) due to their superior mechanical properties and low weight. However, challenges arise from FDM's layer-by-layer approach, leading to inadequate fusion bonding between layers and substantial thermal residual stresses. The proposed Flexible Fusion 3D (FF3D) technique bridges the gap by combining commercially available FDM technology with an efficient post-fabrication fusion compaction process. This approach enables the fabrication of fully 3D components with tailored fiber orientation, complex geometries and topology-optimized structural elements. The paper introduces an efficient control method for the time-temperature-pressure parameter using the FF3D technique across three distinct test samples. The compaction process is demonstrated at three scales: 1) coupon, 2) T-bracket with a dovetail joint, and 3) an automobile pedal.

Investigation of Surface Characteristics on Additively Manufactured Composite

Sung Jun Choi
Student Researcher
Purdue University

Extrude Deposition Additive Manufacturing (EDAM) is a widely used 3D printing technology for thermoplastic composite materials. Pelletized composite materials are melted in an extruder and deposited layer by layer onto a building plate through a printing nozzle. Most fibers align with the printing direction in the printing process. One of the significant applications of 3D printed composites is for building composite part manufacturing tools. The surface characteristics of the tool play an important role in determining its durability, the surface finish quality of composite parts, and the required demolding force for composite part manufacturing. The orientation of the fiber on the tool surface changes with the tool surface angle relative to the printing direction. The surface characteristics influenced by the fiber orientation can vary depending on the surface angle relative to the printing direction. Therefore, understanding the surface properties resulting from different surface angles is essential. In this study, an acrylonitrile butadiene styrene (ABS) composite block filled with 20% carbon fiber by weight was printed using EDAM technology. Surface property test specimens were cut along different planes (1&2 plane, 2&3 plane, and 1&3 plane while 1-printing direction, 2-traverse direction, and 3-stacking direction) and observed under a microscope for fiber content and orientation. Surface characteristics critical for composite tooling applications were evaluated.

Advancing the Use of Sandwiched Composites through Hybrid Manufacturing the Core Structures

Savannah Rose
Graduate Student
Baylor University

Honeycomb sandwich structures are often used in automotive and aerospace applications due to their high strength to weight ratio. The sandwich structures typically have a Nomex or aluminum core that are combined with a laminated composite face sheet on either side. One way to improve the structural properties is to use additively manufactured cores, creating structurally enhanced or directionally biased behavior in preferred regions and the potential for complex shapes. Additive manufacturing allows for increased material availability, lower cost, and freedom of design, in addition to tunable properties. The core geometry studied in the present research is a spheroidal shape, allowing for more quasi-isotropic properties and variable density. The sandwich structure manufacturing process is to 3D print the core out of nylon using fused filament fabrication (FFF). Then, the carbon fiber laminate thermoset layup is fabricated and cured. Finally, the face sheets are adhered to the core with an aerospace grade adhesive. These structures are then compared to an equivalent structure fabricated with a Nomex core through flatwise and edgewise compression testing. The samples are taken up to failure and the results are compared in this study. From the flatwise compression tests, the additively manufactured cores could hold a load three times that of the baseline Nomex cores, while for the edgewise compression the load capabilities equivalent to the currently employed Nomex structures.

Introduction of Continuous Fiber Thermoplastic Tapes and Laminates into 3D Printed Structures

Jonathan Spiegel
Senior Engineer
Polystrand, Avient Corporation

There are several methodologies currently employed to introduce continuous fiber thermoplastic materials into the 3D extrusion printing process. Most of these processes require the presentation of fiber tows through an extrusion head or nozzle. These fiber tows may be introduced dry, and impregnated in-situ in the extrusion process, they may be pre-impregnated with a thermoplastic matrix and extruded in conjunction with additional material, or they may comprise the entirety of extrudate. These existing processes face some inherent limitations. In particular, due to the nature of the extrusion process, proper alignment and tensioning of reinforcing fibers (critical to optimizing mechanical performance) can be challenging to achieve. Additionally, throughput is limited to the volume of material that can be introduced through the extrusion head/nozzle in a given timeframe. The technique outlined in this presentation will demonstrate a method that introduces pre-impregnated and pre-consolidated continuous fiber thermoplastic tapes and multi-axial laminates into the 3D printing process as a secondary operation. This can be performed in parallel with the extrusion printing process, allowing the selective addition of these higher strength materials where needed in a particular structure. Depending on the size and shape of the structure being printed, this methodology can be employed with little to no impact to the throughput of standard extrusion printing technology.

ADVANCES IN THERMOPLASTIC COMPOSITES

ATSP Innovations Estherm Oligomer for Enhancing Properties of Certain Thermoplastics

Fred Deans
Owner
Allied Composite Technologies, LLC

ATSP Innovational's Estherm C-series oligomers are a high temperature and chemical resistant thermoset polyesters specially processed to be used as modifiers and hardeners for thermoset and thermoplastic resins. Applications of C-series oligomers imparted to thermoplastic resins such as polyamides, polyesters, and polyurethanes including reduction in viscosity, improved fiber wet-out, and improvements to mechanical and properties. C-series oligomers can serve as a hardener phase for thermoset epoxy and polyester thermosets.

Thermoplastic Structural Composites for Sustainable Weight Reduction of Automotive Components

Chris Johnston
CEO
Aerlyte

Thermoplastic composites are suitable material for energy absorption showing impressive mechanical performance and are sustainable materials which can mechanically be recycled. Material formats are key for economic processing and therefore different formats and related process technologies will be introduced. For larger and more structural parts latest processing techniques are considered. A typical example is tape/organosheet placement, followed by a consolidation process. Materials have been optimized to allow for efficient tape placement processes, followed by oven consolidation (Out of Autoclave Processing), in order to provide a cost efficient and robust approach. This presentation will highlight latest applications of thermoplastic structural components such as skid plate or battery cover/floor structures and will introduce a new pick-up truck box concept based on a structural sandwich panel utilizing Johns Manville NeoMera organosheet for the skin materials without any crossmembers and endurance tested with maximum load for over 100,000 cycles. Based upon the elimination of the 3 central crossmembers at least 5 kg in reduced mass over the GF/PP version making this version lighter than the 1-Piece cargo box, can be expected. In addition, the NeoMera version offers the opportunity for further mass optimization as it currently exceeds OEM performance criteria.

Continuous Fiber Reinforced Thermoplastic Tape Laying and Consolidation for Automotive Cycle Times

Louis Kaptur
Senior Business Development Officer
Western University

Light weighting is becoming increasingly important for new electric vehicle architectures as well as SUVs and Trucks. This has created an increased demand for lightweight high-performance materials such as continuous fiber reinforced thermoplastics. This presentation will look at an automotive product case study of a continuous fiber reinforced thermoplastic structure. Automated tape laying and consolidation systems were employed to manufacture part specific continuous fiber reinforced thermoplastic tailored blanks prior to press forming. The production process will be described in detail including a cycle time analysis during a production run. Also, the material saving benefits of near net shaped tailored blanks will be highlighted.

Development of a Novel Light Weight Reinforced Thermoplastic (LWRT) for Automotive Applications

Richard Kim
Product Developer
Hanwha Azdel

Light weight reinforced thermoplastic (LWRT) has emerged as a promising material for automotive applications due to its excellent mechanical properties, low density, and recyclability. LWRT can be used in various automotive components, such as head liners, underbody shields, trunk trim, and rear window trim. Reducing the overall weight of thermoplastic parts while maintaining mechanical properties has been a focus in the automotive industry over the past decades to improve fuel efficiency and reduce carbon emissions. In this paper, a novel LWRT has been developed with a remarkable strength-to-weight ratio, and it can be molded into complex geometries with varying thicknesses. In order to achieve superior mechanical properties, a high consolidation level is applied during the manufacturing process. Compared to a standard LWRT counterpart, this new LWRT material can maintain the same level of mechanical properties with reduced basis weight. ASTM D790 method was used to benchmark the mechanical properties, including flexural peak load and stiffness, against a traditional LWRT. Physical properties such as basis weight and density can be adjusted to meet various requirements.

Use of Thermal Black as Filler in High Performance HDPE Films

Mihaela Mihai
Senior Research Officer
National Research Council of Canada

This work presents the development and the performance of high-density polyethylene (HDPE) and Thermal Black (TB) Thermax N990 composite films. TB is the purest form of carbon black commercially available. Contrarily to the common furnace carbon black (CB) derived from the burning of organic oils, TB is manufactured in a more sustainable way, by the decomposition of natural gas in the absence of oxygen. TB has a larger particle size, lower surface area, and lower level of particle aggregation while being an eco-friendly grade. The industrial films market is expected to grow from $39.3 billion in 2020 up to $49.0 billion in 2025. Due to this market potential, the replacement of petroleum-based HDPE by TB to manufacture films would lead to an important reduction of its environmental impact. This work presents the utilization of TB to fabricate HDPE/TB films. HDPE/TB composites were compounded with 3 to 40 wt.% TB. The compounds were used to fabricate films by film casting, film blowing, and bi-axial orientation. Films with thicknesses of 10 up to 100 microns were characterized in terms of microstructure, mechanical, optical, thermal, and barrier properties. Their performance was compared with films containing CB made using same processing conditions and with commercial HDPE films. HDPE/TB films showed excellent mechanical, optical, and barrier performance, therefore proving to have the required level of performance for many industrial applications.

Green Composites From Hop Natural Fiber and Bioplastic

Arturo Rodriguez Uribe
Research Associate
University of Guelph

Hop natural fibers derived from attrition milling processing are used as reinforcements for poly(butylene succinate-co-butylene adipate) (PBSA) to produce a biodegradable materials. An in situ prepared maleic anhydride grafted PBSA was used to improve interfacial adhesion. The quality of the materials was evaluated via mechanical, thermal characterization, as well as morphological analysis. The fiber was obtained in the sizes of 0.25 mm, 1 mm, and 2 mm and the loading in the composites was of 30 wt%. The results indicated that the fiber's size distribution plays a crucial role in the performance of biocomposites as well as the use of coupling agent. The 1 mm fiber-reinforced biocomposite showed optimal performance. This was correlated with the comparatively narrower particle size distribution. With the use of the coupling agent properties of composites such as the tensile strength, flexural strength, and impact Izod notched improved ~40 respect to non-compatibilized composites. These results are supported by the SEM morphological analysis that show the effective fiber-matrix bonding.

Restoration of Strength in Polyamide Woven Glass Fiber Organosheet After Impact Using Hot Pressing

Mohammad Nazmus Saquib
Graduate Assistant
Old Dominion University

Thermoplastic composites reinforced with woven fabrics have emerged as a promising solution for electric vehicles (EVs) in applications such as battery enclosures and body panels, offering benefits like cost savings, lightweight design, impact resistance, formability, and recyclability. Ensuring the production of impact-resistant EV components is of utmost importance. In this study, we investigated the post-impact behavior of glass fiber 2/2 twill woven fabric reinforced polyamide 6 (Nylon) organosheets at various impact energies. Our experimental approach involved subjecting the composite specimens to impact at different energy levels using a drop tower test rig, followed by compression after impact (CAI) tests. The results highlighted the exceptional damage tolerance and improved residual compressive strength of the organosheets, attributed to the matrix ductility that reduced transverse crack propagation. To address impact-induced damage, a localized hot pressing repair system was developed, which successfully restored the organosheets' strength. These findings demonstrate the potential of woven GF/PA6 organosheets as a cost-effective and impact-resistant material system.

The Lightweight Solution for Underbody Protection Panels of BEVs: Glass Fiber - PP Organo-sheets

Udo Steinhauer
Director of Business Development and Marketing
Profol

The number of Battery Electric Vehicles (BEV) sold worldwide in 2022 was 7.3 million, with an expected annual growth of more than 30% in the next few years. The battery boxes of BEVs are usually built into in the car body, and the experience in the recent years has shown that additional protection of the battery box is necessary to avoid damages through impacts and consequently the destruction of the battery cells. However, the additional weight of such a protective shield must be limited as much as possible not to affect the range of the BEV. Selecting the most suitable material is difficult because a high strength-to-weight ratio is required to achieve high impact resistance. A material for a protective shield must also be easy to shape and form, as it is not just a flat plate, but an individual structure and design of the component per vehicle platform. Ideally, the material should be corrosion resistant and support noise reduction. Finally, the shield solution must be cost-effective. Glass fiber - PP organo sheets made from UD-Tapes are the lightweight solution to meet all these requirements for underbody protection shields. In this presentation, mechanical strength and impact resistance data for different layer models of organo sheets will be presented, demonstrating the excellent suitability of glass fiber - PP organo-sheets for underbody protection panels of BEVs.

ADVANCES IN THERMOSET COMPOSITES

Effect of Starch-based Hybrid Additive on Mechanical & Thermal Properties of Epoxy-based Composites

Lynsey Baxter
Material Applications Engineer
MITO Material Solutions

As industry shifts towards the use of renewable, sustainable materials, research focusing on green and biobased materials has expanded. One area of particular interest is the use of starch to create eco-friendly, bio-based additives for use in thermoset and thermoplastic composites. This study focuses on the evaluation of easily integratable, functionalized starch-based additives for use in epoxy resin and carbon fiber reinforced composites. Composite test panels with 0.1 and 0.5 wt% of these starch-based additives were created and the mechanical performance of the additive-enhanced carbon fiber reinforced composites was evaluated according to ASTM standards for tensile, interlaminar shear strength, and flexural properties. The results of this study showed that the bio-based functionalized starch additive can provide mechanical improvement where additive loading can be tailored for targeting specific properties. The findings also showed that easy, uniform, and stable dispersion can be achieved by introducing specifically advantageous functional groups to the starch structure in a scalable approach.

Metal Organic Thickeners for Styrene-Free Resins in Sheet Molding Compound

Eric Martin
Research Engineer
Fraunhofer Innovation Platform for Composites Research

In recent years more stringent regulations have been introduced to lower volatile organic compound (VOC) emissions. The desire to reduce VOCs will have an impact on styrene, which is a key component in most commercially available SMC. Many resins produced for SMC compounding use styrene as a diluent to achieve lower viscosities necessary for proper fiber impregnation. The SMC paste must have a low initial viscosity, then it must increase in viscosity for handling and molding. To achieve this rheological behavior, a thickening agent (predominantly magnesium oxide or MgO) is added to the SMC paste mixture. Unfortunately, MgO has been unable to thicken some commercially available thermoset resins which could have potential in the SMC industry. Over the last few years novel thickening agents have been developed based on aluminum complex chemistry. These aluminum based thickeners have provided an attractive alternative to MgO for typical polyester SMC resins due to reduced influence of moisture on thickening behavior and reduced viscosity drift once targeted molding viscosity is reached. The new thickeners have also demonstrated the ability to thicken styrene free resins which cannot be thickened using MgO. A novel aluminum based thickener has been used to compound a styrene free SMC, which illustrates the ability of this chemistry to help the industry transition to meet new regulatory requirements.

Snap Cure Resin for High Rate FST Rated Automotive Composites

Henry Sodano
CEO
Trimer Technologies

Trimer Technologies has developed a high-performance thermosetting resin that provides cure times as fast as 30 seconds while achieving the mechanical properties of 350 F (177 C) cured epoxies with a Tg greater than most BMIs. Although the resin exhibits a fast cure, it offers a long gel time to enable infusion of large components and greatly exceeds FAA fire resistance standards for aircraft interiors. This presentation will describe the unique processing and material properties offered by Trimerâ€™s new resin.

Next Generation Polyolefin Thermosets for High Volume HP-RTM Mobility Applications

Jeffrey Valentage
Americas Automotive Market Development Manager
Materia Inc.

MateriaTM, a subsidiary of ExxonMobil, has developed innovative polyolefin based thermoset solutions that can unlock significant value across a wide variety of processes, market segments and end use applications. ProximaTM offers super-low viscosity, low density, tunable cure, and improved performance versus traditional thermoset systems. Our Nobel prize winning proprietary technology overcomes traditional composite material tradeoffs and enables the development of next generation high-performance thermoset composite applications in mobility. In collaboration with Fraunhofer Innovation Platform for Composites Research @ Western University (FIP-Composites@Western) the presentation will review development activities of HP-RTM with ProximaTM and explore future opportunities.

BONDING; JOINING AND FINISHING

EVO PTÂ®: The Self-Tapping Evolution in Clamp Load Generation for Highly Engineered Plastics

Thiago Kalife
Applications Engineer
EJOT-ATF

Direct self-tapping into plastic materials is a proven market solution for multiple different materials ranging from standard compounds to highly engineered composites. Some of the benefits of implementing this type of fastening solution are increase in joint performance, eliminating threaded inserts and improving installation times and final product quality while minimizing cost-per-joint impact. To tackle the ever-evolving plastics, ATF's EVO PTÂ® presents itself as a new thread type that successfully improves from previous generation fasteners while retaining the benefits that made its predecessors industry-leading solutions. While superior torque performance is the easiest to prove, measure, and replicate in an assembly line setting, a fastener's true purpose is to generate and retain clamp load. With the introduction of the EVO PTÂ®, the reduced thread friction generated in the self-tapping process allows for higher available torque to generate more clamp load in the joint when compared to existing competing products. Then, with the correct torque setup, achieving higher clamp load values no longer risks joint integrity for soft or brittle components like electronics, and allows for weight reduction and performance commonization across multiple fasteners.

Ultrasonic Welding Optimization of Continuous Carbon Fiber Thermoplastic Reinforced Composite Plies

Harry Lee
Undergraduate Research Assistant
Purdue University

Ultrasonic spot welding is often used to fix fiber-reinforced thermoplastic composite piles before consolidation in a tool. However, the temperature development during the ultrasonic spot welding of continuous fiber reinforced thermoplastic composite plies is not fully understood, and there are no guidelines for determining an optimal welding parameter. Improper welding parameters can cause thermal degradation, fiber breakage, warpage, or incomplete welds. In this research, different welding amplitudes were used to weld 8 plies of carbon fiber-reinforced polyether ketone ketone (PEKK) composite plies. A thermal camera was used to measure temperature development and distribution over time, and the output power from the welding system was recorded simultaneously. The thermal data showed different transient temperature responses for different amplitudes. 20 to 50% amplitude did not weld, but the temperature rose and plateaued below the glass transition temperature. 60% and above allowed the thermoplastic to soften and welded all the plies together. The transient temperature responses showed three stages, which were the build-up, welding, and steady-state stage. Increase in amplitude caused faster temperature increase, higher peak temperatures, and higher steady-state temperatures. The clear relation between power and internal temperature showed potential to be used as an indicator for a completed weld, far more practical than measuring the internal temperature.

Influence of Waterjet Cut Quality for Fabrication of Test Specimen on Mechanical Testing Results

Jacob Montrose
Graduate Researcher
Purdue University

Abrasive waterjet is an effective method of cutting fiber reinforced composites as it allows for precise cuts without introducing any thermal effects or direct contact with the cutting tool. In composite research, the fabrication of accurate and undamaged test specimens is crucial for testing their mechanical and physical properties. The cutting edge of the test specimen can be varied based on the speed of the waterjet cutting. The quality of the cut edges can have a significant impact on the test result since stress concentrations can be introduced differently under loading depending on the roughness of the edge. In this study, fiber reinforced composite tensile test specimens were fabricated using an abrasive waterjet with different cut qualities. The cut edge quality will be assessed using visual inspection, microscopic image, a surface roughness tester, and a scanning electron microscope. A tensile test was conducted with the test specimens cut with different cut qualities. Digital Image Correlation (DIC) technology will be used to track the local strain change during the test to investigate any stress concentration different at the edge when different cut quality was used. The tensile test data will be analyzed and presented to address importance of using proper abrasive waterjet cutting parameters for fabricating composite test specimen.

CARBON COMPOSITES AND REINFORCEMENTS

Carbon Fiber from Corn-stover-derived Lignin: Effect of Molecular Weight on Processing & Properties

Sagar Kanhere
Post Doctoral Fellow
Center for Advanced Fibers and Films, Department of Chemical Engineering, Clemson University

Carbon fibers have a high specific tensile strength and modulus, making them desirable reinforcement fibers for composite materials. Carbon fiber-reinforced composites can double the weight savings compared to glass-fiber (GF)-reinforced composites. However, the high cost of carbon fibers prevents them from being used in automotive applications. More than half of the cost of carbon fibers comes from the cost of the precursor; hence to make carbon fibers affordable for automotive applications, it is necessary to use cheaper precursor fibers. Lignin is an aromatic bio-derived polymer available and investigated as a potential low-cost carbon-fiber precursor. Corn stover is the agricultural residue generated during corn kernel harvesting, consisting of about 60% cellulose and 20% lignin. The cellulosic portion of corn stover is being investigated as a potential source of biofuel. Consequently, corn stover-derived lignin could become a widely available and potentially cheap precursor. This study used fractionated lignin of different molecular weights to investigate its effect on the processing and properties of carbon fibers. Precursor fibers were successfully dry-spin into lignin precursor fibers. It was found that high molecular weight lignin fibers stabilize faster, reducing the time by a factor of four. The resulting carbon fibers have a tensile strength of 1.0±0.1 GPa, twice that of the previously reported value, and a tensile modulus of 82 GPa, exceeding that of GF.

Extrusion Deposition/Compression Molding of Hybrid Carbon/Glass Fiber Thermoplastic Oil Pans

Brian Knouff
Research Lead - Composite Manufacturing
Oak Ridge National Laboratory

Ford and Solvay have collaborated on a program with ORNL (Oak Ridge National Laboratory) to fabricate all-composite oil pan prototypes. Ford provided the design of the oil pan, ORNL ran the FEA (Finite Element Analysis). ORNL contracted Additive Engineering Solutions in Akron, OH to make the tool, Solvay provided the material, and ORNL fabricated the oil pans. The material chosen was Solvay's Amodel AXS-1665, which is a hybrid reinforcement of fiberglass and recycled carbon fiber in PPA (polypthalamide), which was specifically designed to work in automotive environments. The fabrication process was extrusion deposition-compression molding (EDCM) and performed at the Manufacturing Demonstration Facility (MDF) in Hardin Valley, TN. The extrusion was performed using a Trinks Plasticator, which utilizes a hydraulic reciprocated single screw, to prepare the material for molding. The resulting charge was then placed into a tool located inside a Trinks 500 lb. fast-acting press. This press enables the tool to be shuttled in and out of the press, allowing a safe and efficient way to place the charge into the tool and then shuttle inside the press for molding. A total of 7 oil pans were fabricated for testing. This paper details the design of the oil pans and tooling, and the optimization of the fabrication. Finite element analysis was performed for the tooling design and mold flow analysis for the fabrication.

Crack Growth Monitoring and Fatigue Analysis for CFRPs Using Ultrasonic Inspection

Khaled Matalgah
Baylor University

Carbon Fiber-Reinforced Polymers (CFRPs) are extensively used in various applications which include the aerospace, automotive, and civil engineering industries, among others. Fatigue crack growth is one of the main causes of premature failure in aircraft structural components. Therefore, predicting fatigue life is essential to avoid catastrophic failure. The detection of any subsurface flaws that arise either during manufacturing or service use are critical to avoid component failures. Non-destructive testing (NDT) is commonly used to evaluate CFRP components without causing damage providing insights into the structural integrity of these components. In this paper, CFRP end-notched flexure (ENF) samples were tested via the 4-point bend test setup, to observe and predict stable crack propagation. The extent of crack propagation was monitored via ultrasonic inspection at various stages of the fatigue testing process. Various stages of delamination damage measured via ultrasound served as into our ENF ABAQUS Finite Element Analysis model, which was subsequently used to simulate future crack growth under fatigue loading. Simulation results of fatigue crack growth compared well with experimentally measured fatigue damage.

Automated Foreign Object Detection for Composite Laminates Using High-Resolution Ultrasound Testing

Rifat Ara Nargis
Graduate Student
Baylor University

Carbon fiber laminates have great potential in manufacturing parts of high strength and stiffness but are lightweight because of its high strength to weight ratio. Carbon fiber laminates have other advantageous qualities like toughness, high dimensional stability, vibration damping, low coefficient of thermal expansion, etc. To get the best results from these properties, the fibers need to be aligned, straight and very well bonded. The presence of defects, specifically, foreign object debris (FOD) in the form of Teflon, Kapton films, peel-ply strips, gloving material, etc. can compromise the desirable qualities of the laminates, sometimes causing catastrophic failure. This paper presents an automated detection and sizing of FODs with the help of pulse-echo ultrasound testing outside of an immersion tank. This method uses a custom automatic edge detection technique and is highly accurate. The results in the present study show an error less than 0.025" in quantifying the critical dimension for the circular FOD and less than 0.10" for the triangular FOD. Teflon inserts of two different shapes, a nominal 0.50" diameter circle and a 3-4-5 triangle with a nominal 0.50" hypotenuse, were embedded in a woven fiber carbon fiber laminate at different depths. The samples are conditioned and investigated in several different environmental conditions ranging from 5°C to 50°C and from 10% Relative Humidity (RH) to 90% Relative Humidity (RH).

Agility and Accuracy: Phased Array vs Single-Element Ultrasonic Testing in the Characterization of Barely Visible Impact Damage in CFRP Laminates

Rachel Van Lear
Undergraduate Research Assistant
Baylor University

Damage of carbon-fiber laminates due to impact in-service or during maintenance is often difficult to evaluate visually. Unlike metallic systems, the real damage to a laminate is often beneath the surface and cannot be quantified using optical or surface inspection methods, often being termed barely visible. Sub-surface, non-destructive testing methods, such as ultrasonic testing, are useful in detecting the three-dimensional nature of barely visible impact damage. To quickly detect and quantify such damage, there has been an increasing industrial push towards utilizing phased array ultrasonic testing methods. This relatively recent adoption of phased array ultrasonic testing poses the need for determining the speed and accuracy of the scanning method for impact damage as compared to the more established but time consuming conventional single-element transducer ultrasonic testing techniques. This study compares these two ultrasonic testing techniques by impacting 22-layer carbon fiber laminates using a drop tower with 16J, 18J, and 20J energies, ultrasonically scanning the resulting damage area, and comparing the quantification of the impact damage zone along with the scanning time between techniques.

COMPOSITES IN ELECTRIC VEHICLES

Development and Validation of an EMI Enhanced SMC Compound for BEV Applications

Adam Halsband
Managing Director
Forward Engineering North America (FENA)

The shift to electrified powertrains and autonomous vehicles is driving an increase in demand for flexible, scalable cost effective structural components. This trend combined with advancements in polymer composite technologies is creating more opportunities for the inclusion of composite structures. However, an unintended consequence of replacing metal components with fiber reinforced polymer (FRP) composite parts is that these alternative parts typically lack intrinsic electromagnetic interference (EMI) shielding which is otherwise taken for granted with metallic components. Successful EMI shielding solutions require a comprehensive approach to Design, Materials and Process. Optimal structural composites solutions leverage the attributes of the materials of construction to deliver both mechanical and functional performance. Leveraging this approach, the team initiated a program to develop and validate a capable EMI Enhanced SMC Compound. In this presentation, we will share the status of the development of an EMI Enhanced SMC Compound, results of molding and forming trials, the development of a capable Test Method for Evaluating EMI Shielding Effectiveness of formed SMC Panels, and the results of a comprehensive series of EMI Performance Test Trials conducted on an EMI Enhanced SMC Compound, and currently accepted solutions.

Lightweight Hybrid Composite Design for E/V Battery Pack Case to Enhance Safety and Productivity

Jong Hyun Kim
Research & Development Director
Hanwha Advanced Materials

The development of lightweight technology for battery pack cases is a key focus in the electric vehicle industry. In this study, we present a hybrid composite material design that integrates both chopped GF-SMC and woven GF-SMC for the upper case, lower case, and protection cover. Specifically, the upper case is made of fire-resistant material to prevent thermal runaway, while the lower case is designed to absorb shocks and maintain a lightweight structure that protects the battery from external impacts. To achieve weight reduction, we applied molding techniques to integrate the components and utilized the hybrid material design, resulting in a 30% reduction in weight. This technology not only enhances the efficiency of battery management but also increases productivity through a more integrated and simplified design. The lightweight technology we propose has the potential to significantly improve the efficiency and practicality of electric vehicles, providing a solution for reducing the overall weight of vehicles while ensuring battery protection and safety. Overall, our findings demonstrate the feasibility and potential of our lightweight technology in the battery pack case for electric vehicles.

The Interdependency of Design, Materials, and Manufacturing to Optimize a Composite Battery Solution

Greg Poterala
eMobility Marketing Manager
Solvay

The requirements for a battery enclosure are complex and constantly evolving. Composites are considered for lightweighting advantages but must meet a number of challenging requirements, including crash, stiffness, NVH, thermal management, thermal runaway, and many others. In order to meet the performance and cost targets many factors must be considered. Solvay has worked with global industry experts to develop a comprehensive understanding of the advantages and limitations of a composite battery enclosure. Enclosure design, material selection, and manufacturing methods cannot be addressed independent of each other, they must be addressed simultaneously. Only when all three are considered and understood, can an optimized solution be proposed. Solvay will present a composite design that addresses all of the significant concerns for an automotive battery enclosure while providing market leading energy density and specific energy benefits.

Flame Retardant Intumescent Sheet Molding Compound for Electric Vehicle Battery Cover Application

Steven Prascius
Materials Development Engineer
Teijin Automotive Technology

In recent years, the electrical vehicle market has expanded rapidly and is expected to continue growing in the coming decade. While the adoption of electric vehicle technology provides many advantages over internal combustion engine vehicles, there are drawbacks. One such drawback is the potential danger of a thermal runaway event which is the uncontrolled increase in temperature and pressure due to damage to lithium-ion batteries that could lead to a battery fire. This danger has highlighted the increasing need for flame retardant materials for electric vehicle battery covers to help mitigate risk during such an event. One such material well suited for this challenging application is intumescent sheet molding compound (SMC). Intumescent SMC meets the strict thermal requirements of OEMs and international standards for battery cover applications, while also meeting the physical requirements of traditional battery cover materials. This material provides superior insulative and flame-resistant performance with a <10 second after flame time in UL94-5VA and passing results in UL 2596 with a max panel temperature of < 370 degrees Celsius at 3 mm. In simulated thermal runaway testing, intumescent SMC has a max panel temperature of < 340 degree Celsius and a char strength of > 200 N after a 30-minute burn at 3 mm. Intumescent SMC has a tensile strength of > 110 MPa, a tensile modulus of >10 GPa, a specific gravity of 1.55 g/cc, and has proven automated production readiness.

Material Selection for Automotive Fire-resistant Applications

Ian Swentek
Senior Applications Development Manager
Westlake Epoxy

Occupant passenger safety remains at the forefront of automotive design requirements even as electric vehicles (EVs) represent a growing portion of the annual vehicle sales. Within this EV market, consumer demand for comfort and range necessitates a large, energy-dense battery system that represents a potential thermal hazard. A battery thermal runaway is a serious and challenging event to mitigate. Vehicle manufacturers have a variety of options to address this thermal hazard: materials, process, and design. The local legislative boundary conditions also impact the allowable options and the required minimum performance. Proper material selection thus involves a robust understanding of the requirements, available materials, and suitable manufacturing processes for a given design. Following a brief market survey, a case-study approach is used to highlight the spectrum of different fire-resistant targets and their corresponding commercial solution. The focus is toward thermoset composite technology solutions with a global market view. Several trends will be presented along with an outlook of the shift in material selection for automotive fire-resistant applications.

ENABLING TECHNOLOGIES

Simultaneous Estimation of In-Plane Permeability and Porosity in Fiber Reinforcement

Anand Bora
Customer Success Account Manager
Moldex3D Northern America, Inc.

Resin Transfer Molding (RTM) is a popular method for manufacturing high-strength, lightweight fiber-reinforced plastics. In RTM, permeability and porosity are crucial properties that affect resin flow in fibers and the accuracy of numerical simulations. However, measuring these properties separately can be time-consuming and expensive. To address this issue, we developed a new measurement system that combines capacitive sensing and flow visualization signals to simultaneously estimate in-plane permeability and porosity. Our proposed method is simple and cost-effective, and the feasibility is demonstrated through experiments and numerical simulations in this presentation.

Smart SMC Cutting and Stacking Solutions in Conjunction with Advanced SMC Production Lines

Raimund Grimm
Sales Manager
Dieffenbacher

In times, where costs for material and energy are rising and the supply chains are uncertain, it is the most important to rely on existing production capability and machines as well as making the best use out of resources. A smart SMC Cutting and Stacking unit in conjunction with advance SMC Production lines and digitalization solutions, all provided by Dieffenbacher, as turnkey solutions offer exactly that. The Dieffenbacher Fibercut helps to maximize your material utilization and reducing your scrap rate, by an integrated weighing and compensation cut function. Combined with a Dieffenbacher Press, which is equipped with an advanced parallel levelling system, it will be ensured that the material flow precisely fills the mold while reducing eccentric loads on the tool and press. This increases the production lines' uptime and expands the machine's lifetime while reducing maintenance costs. Combining all production line participants with the Dieffenbacher digitalization platform EVORIS, data collection throughout the production line and further evaluation of the data will be enabled. EVORIS and the collected data can be used to analyze and adapt the machines as well as the processes to ensure the best possible outcome for a robust production, better material economy and consistently high part quality.

Accelerating Sustainable Composites Manufacturing with Dielectric Sensors and Machine Learning

Alec Redmann
Business Development Manager
NETZSCH

The automotive industry worldwide is facing pressure to develop sustainable, productive, and cost-effective manufacturing processes for composite parts. However, manufacturing polymer composites can be difficult due to various factors such as changes in material batches, environmental conditions, and complex material behavior. These issues can result in unpredictable part quality and lead to conservative cycle times, heavy reliance on post-production quality control, and significant waste. This study shows how dielectric sensors, machine learning, and material models can be combined to provide live monitoring, prediction, and optimization during the manufacturing process. The sensors collect critical process data in real-time, such as flow front, viscosity, glass transition temperature, and degree of cure, which are used to train machine learning models. These models create predictions based on the material kinetics and dynamically adjust equipment settings at the beginning of the manufacturing operation to ensure consistency in quality and optimize cycle time. The study also explains the measurement principles for dielectric analysis and provides examples of its application in composite manufacturing. A case study demonstrates how this solution was used in a fully automated thermoplastic resin transfer molding process (T-RTM) to produce composite battery enclosures.

A Novel Technology to Manufacture Exterior Honeycomb Parts that are Ready to Paint

Elias Shakour
Technology Leader - Composites Applications
BASF Corporation

Honeycomb technology is considered one of lightest composites technologies in the industry. Owed to its architecture, it upholds high strength and high stiffness due to the flexural rigidity. With this technology in mind, the automotive industry started exploring honeycomb for exterior applications such as hardtop roofs. To further develop the exterior polyurethane honeycomb application, this study will introduce two polyurethane systems: the first polyurethane is bio renewable polyurethane for the STM process to manufacture the paper honeycomb part, the second polyurethane is introduced into the reaction injection molding (RIM) tool that has a primer layer sprayed on one side of tool to form ready to paint honeycomb as an exterior part. This study will review existing challenges within honeycomb, then will introduce the development of the two-polyurethane systems with the primer. It will discuss the requirements to have all three chemistries to be fully optimized then will review the requirements of manufacturing conditions such as the coefficient of thermal expansion, shrinkage at elevated temperature, elimination of a read through, and how to prepare the part be ready for painting as a class A. Mechanical and environmental performance will be introduced aligned with CEA simulation to demonstrate flow of the polyurethane inside of RIM tool. Finally, the study will showcase how this technology can be used as a sustainable application by using different natural fibers.

Integration of NDT into the Manufacturing Process Chain of Functionalized UD-tape Components

Aaditya Suratkar
Postdoctoral Researcher
Fraunhofer ICT

˜Function integration" has emerged as one of the more efficient lightweighting strategies in the recent times in the field of thermoplastic unidirectional tape (UD-tape) composites. However, defects may be induced at each of the process steps, altering irreversibly the final product quality. One of the effective defect tracking methods is by creating a digital representation of the manufacturing steps and quality characteristics by recording the steps through integration of suitable sensor technologies. In that regard, quality assessment during the production of complex thermoplastic UD-tape composites, using hybrid injection molding with process-integrated Non-Destructive Testing (NDT) and sensors formed the key focus of this study. Three locations in the process chain; UD-tape production, laminate stage, and final component stage, were selected for quality assessment by tracking tape. Thermography and laser systems were used to track the inconsistencies in the UD-tape production step. The collected digital defect information is used to segregate the irregularities in the material by creating cut-outs. The quality of the laminate was then evaluated using integrated eddy-current sensors and that of the final part with ultrasonic testing. The application and potential of these NDT and integrated sensors to create a holistic digital quality footprint for manufacture of highly complex function-integrated parts using thermoplastic composites are discussed in this study

High Performance, Bio-based & Sustainable Sandwich Core Materials for Automotive & Air Mobility

Russell Elkin
Product Development Director
Baltek Inc.

Automobile manufacturing creates unique challenges for FRP composites. This often prevents the consideration of sandwich construction as a solution for lightweighting and designing more sustainable parts. Furthermore, EVs have created new opportunities for manufacturers to take advantage of sandwich composites such as battery boxes. While sandwich is utilized extensively in aerospace, the part volumes & cycle times for air mobility are more akin to automotive. Traditional approaches to material selection and processing make it far more difficult to meet cost and production volume targets. The wide range of closed-cell AIREX foams made from recycled polymers, bio-based BALTEK balsa & SORIC fabric core materials allow designers and engineers to create high performing, lightweight parts with extremely short cycle times with both thermoset or thermoplastic resin systems. These products have advantages over honeycombs in both automotive and air mobility with their inherent functional integration including thermal and acoustical insulation as well as fire performance. Automotive parts currently in production and products already approved for the air mobility market will be introduced..

Enhancing Recycled Thermoplastic Composite Parts Using Recycled Composite Laminate Cutouts

Garam Kim
Assistant Professor
Purdue University

Composite recycling is getting more attention along with increasing global sustainability problems. The mechanical recycling process of fiber-reinforced composite parts transforms long continuous fiber in the composite part into discontinuous short fiber. Since the performance of the short fiber is no longer as high as the long fiber, the application of the mechanically recycled composite is limited. In this research, 2D recycled laminate cutout was used to reinforce the local area, where structurally critical, molded with recycled composite. The remaining continuous fiber in the cutout reinforces the structural performance of the part while the recycled composite pellets adhere the cutouts and fill the rest of the part. As a part geometry, an overhead pin bracket was designed and used. The composite laminate was made of 60% by weight of carbon fiber reinforced PEKK. The 2D cutouts were designed to ensure that the continuous fiber was located where required. Two different cutout combinations were used to make the pin bracket, and the performance of the pin bracket was evaluated by peak stress during the tensile test and compared to a bracket without the cutouts. Digital image correlation (DIC) technology was used to investigate local strain change and failure mechanism of the parts during the test. The test result showed that the properly designed precut improved performance of the recycled part.

MODELING OF COMPOSITES

Opportunities and Challenges of Composites Forming Simulation for Digital Product Development

Dominik Dörr
Co-founder and Managing Director
Simutence GmbH

Lightweight design is an important enabler for reducing greenhouse gas emissions and achieving future regulations. Significant potential is offered by continuous fiber-reinforced polymers due to their excellent weight-specific mechanical properties. Their capability to be shaped into complex geometries, however, is rather limited. Manufacturing simulation through composites forming simulation enables the prediction of manufacturing defects, such as local wrinkling or gapping, and therefore enables the virtual design and optimization of manufacturing processes. Moreover, manufacturing effects, such as the local fiber orientation, become predictable. This information can be used to increase the prediction accuracy of downstream FEA, such as warpage or structural analyses through a virtual process chain. However, virtual process chains and composites forming simulation are not asserted yet as standard tools in product development. In this presentation, a standard procedure for the virtual design and optimization of composite forming processes as well as for creating a virtual process chain is proposed. Opportunities, but also challenges, of composites forming simulation for digital product development cycles are discussed upon results from different projects with OEMs from the automotive and aerospace sectors.

Press Forming of E-glass Fabric Reinforced Polypropylene: A Numerical Study

Chandra Kishore Reddy Emani
Postdoc Research Fellow
University of Michigan - Dearborn

This study focuses on numerically analyzing the deformation behavior of E-glass fabric reinforced polypropylene (PP) prepreg during press forming. A finite element modeling technique is employed in which membrane and shell elements are superimposed to accurately simulate both in-plane and out-of-plane deformations of woven fabrics under shear loading, while also considering the deformation characteristics of the matrix material. The model can predict the maximum draw depths achieved just before failure for the fabric-reinforced PP. The proposed approach represents the prepreg sheet as a superimposed layer consisting of PP and fabric. Under-integrated membrane elements are used to capture the in-plane shear deformation of the fabric, while fully integrated shell elements are used to account for the out-of-plane bending behavior of the fabric and the deformation of the matrix material during press forming. Press forming simulations were conducted with various initial blank temperatures. The draw depths achieved by the prepreg before failure were compared to those achieved with a single layer of unfilled PP using the identical die-punch setup. Failure in the prepreg occurred in the PP layer, where the plastic strains surpassed the failure strain of polypropylene. The highest shear deformation was observed along the diagonal at the die entry radius, coinciding with the location of failure in the PP layer. Additionally, the fabric layer displayed a tendency to buckle.

Simulating the Effect of Bead Microstructure on Interlayer Adhesion in AM Extrusion-Deposition

Douglas Smith
Professor
Baylor University

Additive Manufacturing (AM) provides and important competitive advantage in automotive due to its unique capability of adding customization without cost at reduced cycle times. AM has found a particular niche in the fabrication of soft assembly tools, molds, casting cores, and fixtures. Unfortunately, the strength of parts made with Large Area Additive Manufacturing (LAAM) polymer composite deposition in the build direction continues to be inferior to the material's in-plane strength due to poor bonding between layers. This paper considers the role of the carbon fiber orientation on the thermo-mechanical response of printed beads during and after the LAAM polymer composite extrusion-deposition process. The effect of fiber orientation and micro voids on the thermo-mechanical properties of the deposited bead are evaluated through a homogenization method with data obtained via microCT. Fiber orientation is modeled with orientation tensors to quantify the alignment of fibers in and transverse to the print direction which are then used to compute thermo-elastic properties of the bead. A finite element polymer interface strength model that computes the degree of adhesion as a function of temperature history in a multi-bead structure is used to assess the relative interlayer strength for various beads produced with and without carbon fiber. Results show that the thermal history has a significant effect on predicted bead adhesion which is largely dependent on the bead microstructure.

Predicting Fatigue Responses for Polymeric Materials

Satvir Aashat
CAE Material Engineer
General Motors

Short fiber reinforced thermoplastic parts that are subjected to mechanical and cyclical loading for a long period of time eventually fail. To prevent premature failure in service, predictability is key when designing load bearing components. The lifetime depends on the nature of the thermoplastic material, but also on the amount of reinforcement, the type of reinforcement and the setup of the manufacturing process. All these ingredients make the fatigue modeling of short fiber reinforced plastic parts highly challenging. Dedicated solutions at several stages of the modeling workflow are thus required. The ingredients needed are (a) an accurate material model for any orientation tensor and any loading type & direction, (b) a procedure allowing us to identify model parameters from a reduced set of experimental data, (c) an efficient structural and fatigue solver enabling the prediction of lifetimes for various types of loading conditions (constant amplitude, random signal, frequency/time domain loadings, etc.) and (d) an overall methodology able to account for stress gradients to deliver accurate predictions for any part geometry and mesh. In this presentation, we will present a solution that allows you to accurately predict the fatigue lifetimes of short fiber reinforced parts for a variable amplitude loading. The framework combines engineering tools that enable design engineers to predict fatigue lifetimes of engineering plastics applications.

Fatigue Crack Propagation of Carbon Fiber Reinforced Composite Laminates

Arief Yudhanto
Research Engineer
Baylor University

The intralaminar crack propagation of central notched CFRP composite laminates is simulated by means of crack tip tracking method in Abaqus/ Explicit. The intralaminar damage is classified into matrix crack and in-plane shear crack. The high-cycle fatigue loading is simulated by means of envelope loading method. Within quasi-static loading regime, the in-plane shear and matrix damage are analyzed based on continuum damage mechanics. Within cyclic loading regime, fatigue damage evolution for both matrix and in-plane shear damage of crack tip element is evaluated based on the Paris law criterion. By means of crack tip tracking method, fatigue damage only evolutes to the tracked crack tip elements. With this method, there is no need to preset cracks anywhere.

SUSTAINABLE COMPOSITES

Sustainable Polyolefin Composites for Today and Tomorrow

Kevin George
Field Development Engineer
GEON Performance Solutions

Responsible choices are around us. As material advancements and market influences evolve, often we are presented with requests to enhance sustainability. Sustainability could be achieved via a variety of ways. Two such approaches are to: (1) effectively utilize recycled content material and (2) use of ingredients derived from renewable sources such as biofibers and maintain or enhance material performance attributes to meet the needs of demanding applications. This presentation will discuss perceptions that limit the adoption of recycled content materials in various systems and applications. These include market factors such as availability of recycle stream and technical factors such as material equivalency derived from the inherent variability. A discussion on material equivalency and variability with selected GEON Resilience R filled polypropylene compounds will be presented, using statistical tools, showing technical data based on multi-lot production data. Bio-fillers have been capturing the attention of the general public as well as OEMs in a variety of industries. GEON has worked in conjunction with various members of the supply chain to develop a (family) of biofiber composite solutions. An overview of recent GEON developments relative to the use of biofibers will be presented.

Novel Cellulose Composites for Automotive Applications

Marton Kardos
Research Scientist
Volkswagen Group of America, Inc.

Natural fiber reinforced plastics offer a versatile solution to reduce the carbon footprint of vehicle products. However, most natural fibers stem from dedicated plants, grown only in specific climates and have to be shipped halfway across the world. Paper, on the other hand, is a material used, collected and recycled in every corner of the world with existing, local supply chains. This offers a reliable, abundant, and cost-efficient resource that is scalable for high-volume series production. Paper composite preforms can be tailored to specific applications and customer needs by changing the type or amount of the cellulose fibers. Preforms can be molded into shape via conventional hot-pressing, while additional features can be realized via back-injection molding. The final part will be recyclable.

Designing for Sustainable Content and Performance in Phenolic Sheet Molding Compound

Hugh MacDowell
Manager of Material Development
Teijin Automotive Technologies

The sustainability of raw materials used in fiber reinforced polymer composites has become a major focus for customers, governments, and corporations globally as an integral component in meeting overall international climate regulatory targets. Although timelines and definitions for sustainability differ across the polymer industry, there is consensus that limiting the amount of newly extracted materials in polymer composites is beneficial to reducing the overall environmental impact of composite products. Phenolic sheet molding compound (SMC) presents a unique opportunity to dramatically increase the total sustainable content over conventional unsaturated polyester and vinyl ester based SMC. This is first achieved by creating an ultra-low free formaldehyde phenolic resin with >85% recycled and biobased content. Additional sustainable additives are used to further increase the overall sustainability of the glass fiber SMC composite. The resulting Sustainable Phenolic SMC has a total sustainable content of over 30% by weight, tensile modulus >17 GPa, tensile strength >140 MPa, and 30-minute burn char strength of >200 N at 3 mm thickness. Sustainable Phenolic SMC shows potential to significantly increase the overall sustainability of polymer composite products in a host of flame resistant applications, including battery enclosures for electric vehicles.

Upcycling the Impossible: Recovered Glass Fiber for a Genuine Circular Economy

David Morgan, *Chief Strategy Officer*
Carbon Rivers

The global thermoset and thermoplastic composite market has spent millions to develop and commercialize recovered glass fiber that is clean and mechanically intact for a genuine circular economy. Carbon Rivers initially collaborated with the U.S. Department of Energy to provide a proof of concept for recovering glass fiber from end of life wind blades. This project was successful, and now Carbon Rivers has commercialized and is scaling up the process and manufacturing. With a multi-stage pyrolysis process, Carbon Rivers recovers clean (i.e., sizing is removed) and

mechanically-intact (i.e., 100% modulus and 85% tensile from feedstock) for wind, building material, marine, and automotive industries. Currently, the rGF intermediates are in PPAP (Production Part Approval Process) with multiple OEMs for non-woven mats and SMC, 3D polymer filaments, and thermoplastic pellets. Carbon Rivers' commercial scale up for the automotive industry includes 200 metric ton per day facilities in Tennessee, Texas, and Pennsylvania. In addition, the pyrolysis process produces ~360 barrels of renewable oil per day for petrochemical, aviation / marine fuel, heavy equipment, and alternative fuels for an ESG circular economy.

Westlake Epoxy's Roadmap to Reduce its Carbon Footprint

Venkata Kameswara Nara
Product Development Manager
Westlake Epoxy

Automotive OEMs have set ambitious goals to reduce the emissions from vehicles as they emerge from the EU green deal and other global targets to achieve carbon neutrality. The implementation of lightweight components contributes to lower emissions in the use phase, but the focus is shifting to the raw materials supply (inputs), part production (process) and end-of-life vehicle recycling. This presentation discusses various initiatives that Westlake Epoxy is taking to reduce the total carbon footprint of our thermosets and accelerate the circular economy. At the outset of 2030, Westlake has announced a goal to reduce scope 1 and 2 CO2 emissions by 20%. There are already many projects in place to deliver on this goal such as input energy optimizations, use of renewable energy instead of fossil fuel-based energy and continuous process improvements. To achieve scope 3 emission reductions, a mass balance approach is followed where we alter our input feedstock with recycled or biomass based content to achieve the desired product quality. These renewable substitutes are mixed with fossil feedstocks and reported on an allocation basis. In this way, we offer products with high renewable content and significantly correlated reduction of their carbon footprint. In addition to our green initiatives, this presentation also delves into the different recycling methods such as solvolysis and pyrolysis that are generally used to treat end-of-life composites.

Use of Thermal Black in PLA Films for Industrial Applications

Sajjad Saeidlou, *Research Officer*
National Research Council of Canada

This paper presents for the first-time methods of fabrication and the performance of films obtained from combinations of Thermal Black (TB) particles, and polylactide (PLA), a compostable polymer. TB is one of the purest and cleanest forms of carbon black (CB) commercially available. In contrast to the common furnace carbon black derived from the burning of organic oils, TB is manufactured in a more sustainable way, by the decomposition of natural gas in the absence of oxygen. TB has a slightly larger particle size, lower surface area, and lower level of particle aggregation, while being an eco-friendly grade. Because of rising environmental concerns, films having low environmental impact are more and more requested. The compostable and bio-based PLA is already used for films with a global market, evaluated at $354 million in 2016, reaching $910 million in 2023. In this work, films based on PLA with different concentrations of TB were fabricated, their properties were evaluated and compared to those of commercial films. PLA biocomposites containing up to 40 wt.% TB were compounded and used to fabricate films by film casting, film blowing, and bi-axial orientation. Unique characteristics of PLA/TB films in terms of their microstructure, mechanical performance, optical characteristics, thermal resistance, biodegradability, and barrier properties were measured and compared to neat PLA and PLA/CB films.

Elements of Sustainability for FRP Composites

John Schweitzer
Vice President - EH&S and Sustainability
American Composites Manufacturers Association

Growing in sustainability-driven markets will depend on a combination of lifecycle assessment to understand a product's cradle-to-gate climate impacts, adopting formulation and process changes to reduce those impacts, recycling plant scrap and end-of-life product into materials used to replace virgin materials when making new product, and describing and quantifying sustainability benefits during product use and at end-of-life. This presentation will describe industry programs to help composites manufacturers reduce climate impacts, improve operational circularity, and use sustainability advantages to grow markets.

Hybridized Coir/glass Fiber Reinforced Polypropylene Composites

Sanjita Wasti
PhD student
University of Tennessee Knoxville

In recent years, to curb the rapidly increasing CO2 emissions, automotive industries are looking for alternative materials that are lightweight, cost-effective and ecofriendly. Natural fiber-reinforced composites are considered the promising alternative to synthetic fiber-reinforced composites. However, their properties such as poor fiber matrix compatibility, comparatively lower strength than synthetic fiber reinforced composites and high moisture absorption limit their application. This can be addressed by hybridizing the natural fiber composites by adding synthetic fibers such as glass and carbon fiber. In this study, we hybridized the coir fiber (40wt%)-reinforced polypropylene (PP) composites by incorporating the glass fiber (0-30wt%). The hybrid composites were prepared by pressing the nonwoven mats prepared via the wet-laid technique. The physical, thermal, mechanical, morphological, and water absorption properties of the composites as the function of glass fiber loading were studied. Results showed that hybridizing PP/coir fiber with varying content of glass fiber (0-30wt%) enhanced the tensile strength and modulus by 50-182% and 54-130% respectively. Similarly, the impact strength increased significantly by 157-474% on replacing 0-30wt% coir fiber with glass fiber. Overall, the study suggests that hybridizing PP/coir fiber with glass fiber can make the final composite a promising material for automotive applications with lightweight and enhanced performance.

2023 SPECIAL EDITION: PARTNERSHIPS ADVANCING COMPOSITES IN AUTOMOTIVE APPLICATIONS: HONDA NORTH AMERICA - CLEMSON UNIVERSITY

Design Development of a Lightweight Carbon Fiber Reinforced Thermoplastic Composite Automotive Door

Amit Deshpande
PhD Scholar
Center for Composite Materials at University of Delaware

Transportation accounts for 1/4th of energy consumption and nearly 1/3rd of CO2 emissions in the U.S., incentivizing lightweighting methodologies. Closure systems, accounting for almost 40% of the vehicle mass, are a candidate for lightweighting using composites. Closures need to meet structural requirements of stiffness, strength, toughness and NVH, while meeting functional and ergonomic requirements such as fit and finish, packaging of electronics, and durability. This restricts the allowable design modifications, thereby posing a challenge in terms of lightweight composite design development. Furthermore, the program objectives set additional requirements; achieve a weight reduction of 42.5% compared to the baseline door, a maximum allowable cost increase of $5/lb. reduced and development of a design and manufacturing paradigm for production of at least 20,000 vehicles annually while aligning with the stringent European 95% recyclability standard. Use of composites not only enabled lightweighting due to higher specific strength and stiffness, but also significant parts consolidation. Many smaller stamped components and reinforcing brackets were consolidated into two distinct continuous carbon fiber reinforced thermoplastic (CFRTP) parts suitable for fast and scaled production using thermoforming. The design approach helped achieved 52% parts consolidation, reducing the tooling and assembly costs, while meeting the baseline door's structural performance requirements.

Performance Evaluation of World's First Thermoplastic Composite Door via Finite Element Analysis

Gang Li, *Professor*
Clemson University

The automotive industry's quest for fuel efficiency and sustainability has spotlighted the process of lightweighting. However, closure systems, despite constituting around 50% of total structural mass, face unique challenges due to strict crashworthiness demands and diverse performance requirements. Addressing these challenges, an initiative sought to reduce a vehicle door assembly's weight by 42.5%, whilst maintaining functional requirements at an incremental cost of under $5 per pound saved. This effort saw the evaluation of various door designs via an integrated approach of design, finite element analysis, and optimization. Assessments relied on static load cases derived from routine and improper usage of the baseline door. Crashworthiness was evaluated through finite element analysis under three non-linear load scenarios. Critical steps included the optimization and validation of material properties at the sub-component level. This discussion delves into these door designs, providing an in-depth analysis of their performance under static and crash load cases. Key aspects covered include design optimization, subcomponent-level study, crash analyses, and a thorough investigation of the process of designing the thermoplastic composite door for optimal crash performance using inputs from a Manufacturing-to-Response pathway.

Digital Lifecycle : Rethinking Auto Product Development with Thermoplastic Composites

Sai Aditya Pradeep
Research Development Engineer
Clemson Composites Center

The surge in adoption of innovative materials such as carbon fiber reinforced thermoplastic composites (CFRTP) is constrained by the conventional automotive product development process. These materials, with high stiffness, strength, recyclability, and short production cycles, are underutilized due to their complex architecture and difficulties in defect prediction and failure behavior modelling. Addressing these challenges requires a shift towards a simulation-intensive development paradigm, incorporating the nuances of material properties and manufacturing impacts on design responses. This forms the backbone of a project aimed at redefining the product lifecycle through a unique Manufacturing-to-Response (MTR) pathway. The MTR pathway introduces a comprehensive virtual chain to capture and emulate material properties, design, and process effects for accurate structural mapping in CAE predictions. This method forms the basis of a mission to design a car door 42.5% lighter than conventional doors while satisfying all functional requirements at a cost increment of less than $5 per pound saved. This discussion explores the MTR pathway, from deriving properties at the coupon level to validation at component levels. It includes the capture of residual stresses during rapid cooling from high temperatures using classical laminate theory (CLT) for structural performance evaluation. Lastly, it highlights the optimization of the crashworthiness of the thermoplastic composite door.

Advanced Manufacturing for Lightweight Continuous Carbon Fiber Thermoplastic Composite Door Assembly

Pal Swaminathan, *Global Sales & Business Development Tepex Americas*
Envalior

Leveraging advanced manufacturing techniques, this study addresses automotive weight reduction by focusing on closure systems, which constitute approximately 50% of a vehicle's structural mass. A key innovation is the use of continuous carbon fiber thermoplastic composites to create an ultra-lightweight vehicle door assembly, reducing weight by 42.5% while meeting all functional requirements. At the core of this innovation is thermoforming, a powerful alternative to traditional sheet metal stamping. This technique, used in tandem with the novel composite material, guarantees the door assembly's strength and ductility, vital for crashworthiness. Additionally, thermoforming boasts quicker cycle times, making it compatible with high-volume production requirements. Critical in this process were draping simulations, which played a pivotal role in predicting the composite material's behavior during thermoforming. This helped to refine the part geometry for manufacturability and also dictated the tool design and manufacturing cell setup. In conclusion, this study illuminates how combining advanced manufacturing with computational simulations achieves automotive lightweighting without compromising safety and functionality. Draping simulations, by directing process steps for precise thermoforming, pave the way towards achieving industry sustainability targets.

SPECIAL TOPIC:
SUSTAINABILITY AND VEHICLE END OF LIFE

Circularity for End of Life Vehicles

Kari Bliss
Principal Sustainability
PADNOS

For decades, industrial recyclers have shredded cars to capture the ferrous and non-ferrous metals. The remaining plastic, rubber, wood, paper, textile, leather, or glass is a complex mixture known as Auto Shredder Residue. In the United States, over 5 million gross tons (11,200,000,000 LBS) are sent to the landfill each year. ASR is used as landfill cover to reduce odor and help capture methane gas. Learn about new advancements to separate and capture the valuable plastics from ELV. Successful trials are complete and the first million lbs. has been produced. PADNOS, family owned, and privately held was founded in 1905. Serving OEMs and Tier 1 suppliers to recycle paper, plastic, metals and electronics. While not the largest, they have more diverse processing capabilities than any other industrial recycler in the world which aids them in solving complex mixed material challenges.

Recycling Plastics from End-of-Life Vehicles: The Final Frontier?

David Wagger
Chief Scientist and Director of Environmental Management
Institute of Scrap Recycling Industries (ISRI)

The success of recycling end-of-life vehicles (ELVs) has depended on their significant recyclable metal content and technologies for profitably recycling ferrous and nonferrous metals. The non-metallic content of ELVs, especially plastics, has instead typically been sent at cost to landfills for disposal as solid waste, due to lack of recycling markets for those materials. Despite substantial research and other efforts, plastics from ELVs are still not being recycled to any significant degree. If this persists, the plastics content of vehicles could become problematic for recycling of ELVs due to economic and other pressures. This presentation will give an overview of recycling of ELVs and explore potential pathways for enabling the recycling of plastics from ELVs.

KEYNOTE ADDRESSES

What Does Disruptive Electrification of Transport Mean for Industrialization of Composites?

Joe Summers
Commercial Director Airborne and Managing Director
Airborne UK

The presentation will show how electrification is disrupting most transport segments and creating new ones. In all cases, the additional mass of batteries creates a need for some degree of weight-offsetting and composites are the obvious solution. However, the very specific demands of carrying batteries are a challenge for composites to meet. Many issues are typical to any new application for composites, trying to balance fixed vs recurring costs, functional performance, sustainability, qualification, and repeatability, but scalability is bringing another dimension of challenge. This keynote will summarize the key functional challenges for composites in a variety of new and emerging segments and focus on how EVTOL brings functional challenges of aerospace, with production volumes more akin to automotive, and how technology developments are trying to solve them.

A Role for Composites in GM's Vision for Simulation-driven Design and Sustainable Material Impact

Jason Coryell
Engineering Group Manager - Advanced Materials Technology
General Motors

The presentation will highlight General Motors' vision to reduce physical testing and move towards a virtual simulation-based design and validation, requiring close collaboration with working partners within the materials and automotive industry communities. The presentation will also cover key aspects of Sustainability to ensure that composites now and into the future are in line with GM's corporate goals to reduce the overall carbon footprint of materials used in GM vehicles.

An Overview of Transportation Trends and Related Opportunities

Gregory Peterson
Chief Engineer
Airspace Experience Technologies (ASX)

The presentation will begin with an historic perspective of the transportation industry and its impact on the supply chain network. It will include examples of timelines for new technologies to emerge and replace mature products. Using this data, parallels to today's evolving markets will be presented. It will review three paradigm shifts in technology that are impacting today's transportation markets including: 1. The transition to substantially more efficient vehicles; 2. The shift from human vehicle control to electronic vehicle control; and 3. The shift from 2D to 3D transportation. The presentation will cover opportunities for plastic/composite suppliers in emerging market sectors, including eVTOLS, as well as providing simple holistic math models showing that high-performance plastics and composites that cost more than base materials can potentially reduce new vehicle costs.

We Don't Just Open Doors, We Lightweight Them: The Journey of Ultra-lightweight Carbon Fiber Reinforced Thermoplastic Composite Door Assembly

Ryan Hahnlen
Principal Engineer and Lead of Strategic Research Operations
Honda Development & Manufacturing of America, LLC

Srikanth Pilla
Director
Center for Composite Materials at the University of Delaware (UD-CCM)

In a project funded by the U.S. Department of Energy (DOE) with collaborative teams from Clemson University and University of Delaware and project partners from HDMA, Envalior (formerly Lanxess/Material Partner) and Proper Group International (Tooling Partner) a cost-effective 45% lighter (compared to steel) door assembly was developed for improved fuel efficiency, reduced vehicle emissions, and optimum sustainability. The keynote will highlight the innovative design, advanced materials, simplified manufacturing and assembly, thermoformability with existing infrastructure, improved safety aided by advanced Finite Element Analysis (FEA) and eco-friendly manufacturing.

DON'T JUST KEEP UP WITH THE INDUSTRY – JOIN ACMA AND LEAD THE WAY

ACMA is the world's leading composites industry trade group. Together, we make composites the sustainable material of preference.

- LEGISLATIVE & REGULATORY ADVOCACY
- MARKET INTELLIGENCE & TECHNICAL DATA
- EDUCATION, CERTIFICATION, TRAINING
- NETWORKING & MARKET GROWTH
- STANDARDS & SPECIFICATIONS
- WORKFORCE DEVELOPMENT
- INDUSTRY EVENTS

ACMA membership is your key to growth and success! Join today at acma.today/joinus

ACMA
American Composites Manufacturers Association

INJECTION MOLDING & DESIGN EXPO

SEPTEMBER 20-21, 2023
NOVI, MI

EXPERIENCE THE FUTURE OF INJECTION MOLDING & DESIGN

Discover the latest technologies, materials and equipment from across the North American supply chain and gain valuable insights from industry experts.

SECURE YOUR FREE PASS AT

Injectionmoldingexpo.com

OR SCAN HERE

Featured speakers:

Carla Bailo
President & CEO
ECOS Consulting

Tom Frank
CEO
Radius Packaging

John Manderfield
Innovation & Design Fellow
Altium Packaging

Christian Herrild
Director of Growth Strategies
Teel Plastics

Jeff Stout
Executive Director, Global Innovation
Yanfeng Automotive Interiors

Bill Wood
Economics Editor
Plastics News

Brought to you by: Plastics News, Injection WORLD

Organized by: AMI, CRAIN COMMUNICATIONS GLOBAL POLYMER GROUP

Call for Nominations

MOST INNOVATIVE USE OF PLASTICS AWARDS

The Automotive Division of the Society of Plastics Engineers (SPE®) is announcing a "Call for Nominations" for its 52nd-annual ***Automotive Innovation Awards Gala,*** the oldest and largest recognition event in the automotive and plastics industries. This year's Awards Gala will be held Wednesday, **NOVEMBER 8, 2023** at the Burton Manor in Livonia, Michigan. Winning part nominations **(due by September 8, 2023)** in 10 different categories, and the teams that developed them, will be honored with a **Most Innovative Use of Plastics** award. A **Grand Award** will be presented to the winning team from all category award winners.

SPONSORSHIP OPPORTUNITIES

This annual event currently draws over 800 OEM engineers, automotive and plastics industry executives, and media. A variety of sponsorship packages - including tables at the banquet, networking receptions, advertising in the program book, signage at the event and more are available. Contact Teri Chouinard of Intuit Group at **intuitgroup.com@gmail.com**.

For more info and to submit nominations, go to:
https://speautomotive.com/spe-automotive-div-innovation-awards/

CATEGORIES:

- BODY EXTERIOR
- BODY INTERIOR
- CHASSIS/HARDWARE
- ELECTRIC AND AUTONOMOUS VEHICLE SYSTEMS
- LIMITED EDITION/ SPECIALTY VEHICLES AND AFTERMARKET
- MATERIALS
- POWERTRAIN
- PROCESS, ASSEMBLY & ENABLING TECHNOLOGIES
- SAFETY
- SUSTAINABILITY

2022 Sponsors

VIP RECEPTION & AFTERGLOW SPONSOR

Celanese
The chemistry inside innovation™

MAIN RECEPTION SPONSOR

سابك
sabic

WINE & FLOWERS SPONSOR

DUPONT

GOLD SPONSORS

American Chemistry Council | Plastics Division

DSM
BRIGHT SCIENCE. BRIGHTER LIVING.

SILVER SPONSORS

ASCEND PERFORMANCE MATERIALS

BASF
We create chemistry

BRONZE SPONSORS

covestro

INEOS STYROLUTION
Driving Success. Together.

INTEVA PRODUCTS

lyondellbasell
Advancing Possible

ADVERTISING SPONSORS

FAST RADIUS

van norman

MEDIA / ASSOCIATION SPONSORS

ACMA
AUTOMOTIVE ENGINEERING
AM ADDITIVE MANUFACTURING
AUTONOMOUS VEHICLE ENGINEERING
CompositesManufacturing
CW CompositesWorld
GARDNER Business Media, Inc.
Plastics Business
PLASTICS DECORATING
spe PLASTICS ENGINEERING
Plastics News
PT Plastics Technology
SAE INTERNATIONAL
Urethanes TECHNOLOGY
WARDSAUTO .COM

ADDITIVE MANUFACTURING

SUBSCRIBE | CONNECT | TRANSFORM

Follow the Advance of Manufacturing's Future

LEARN MORE AT
AdditiveManufacturing.com

CALL FOR PRESENTATIONS

DEADLINE FOR ABSTRACTS - November 15, 2023
DEADLINE FOR PRESENTATIONS - February 1, 2024
EMAIL TO: EAVCONFERENCE@SPEautomotive.com

PRESENT TO INDUSTRY DECISION MAKERS IN AUTOMOTIVE PLASTICS

Be part of the all new SPE Automotive Plastics in Electric & Autonomous Vehicles Conference and learn how electric and autonomous vehicle development is driving innovative automotive solutions.

This event will feature technical presentations, keynote speakers and panel discussions, networking breakfasts, breaks, lunches and receptions, and exhibits that highlight advances in this fast-growing industry.

2024 EAV CONFERENCE SESSIONS AND LEADERS:

BATTERY AND THERMAL MANAGEMENT SYSTEM
Dhanendra Nagwanshi, SABIC;
Dr. Jeff Helms, Celanese Corp;
Maggie Baumann, FRX Polymers

ADVANCED DRIVER ASSISTANCE SYSTEM (ADAS)
Dr. Rodrigo Orozco, Celanese;
JP Wiese, Polyplastics

MATERIAL INNOVATIONS
Mike Shoemaker, Borealis; Paula Kruger, Ascend Materials; Sunit Shah, LyondellBasell

EVOLUTION OF INTERIORS
Dr. Rose Ryntz; Jim Keller, Mankiewicz Coatings LLC;
Jeff Crist, Ford Motor Co

SUSTAINABILITY AND CARBON NEUTRALITY
Dr. Alper Kiziltas, Amazon; Dr. Prasad Soman, Amazon; Drew Geda, Hyundai-Kia America;
Manoj Patnala, Rivian Automotive;

NOISE AND VIBRATION
Andrea Hunt, General Motors; Dr. Xian Jiang, Dow

MANUFACTURING ENABLING TECHNOLOGIES
David Kosse, Ascend Materials;
Steve Vanloozen, Lotte Advanced Materials

EVOLUTION OF EXTERIORS AND LIGHTING
Tom Pickett, General Motors;
Volker Plehn, SABIC;
Mark Lapain, Advanced Composites

Presented by:
spe
AUTOMOTIVE

CONFERENCE CHAIR
Dr. Sassan Tarahomi
+1.989.335.0060

TECHNICAL CO-CHAIRS
Dr. Norm Kakarala
+1. 248.840.6747

Dr. Suresh Shah
+1. 248.635.2482

CONFERENCE ADMIN
James Munro
+1 .248.506.0816

2023 PLATINUM SPONSORS

LOTTE CHEMICAL · ENTEC · sabic · Celanese

2023 GOLD SPONSORS

Alterra Holdings · ASCEND · BASF · BOREALIS · Carbon Polymers · covestro · DOW · EMS · Envalior · Highland Plastics · INTEVA · LG Chem · lyondellbasell · MANKIEWICZ · MOMENTIVE · PRET · SIRMAX · The Materials Group · TRINSEO · WASHINGTON PENN

2023 EXHEBITORS

AKRO · ARKEMA · AsahiKASEI · IMERYS · KURZ · NYCOA · pinfa · RIOKA · SUSTAINABLE RESINS

For more information visit our website at:
SPEautomotive.com

or call
James Munro at
+1 .248.506.0816

Troy, MI April 8-10 2024

EAV 2024

THE #1 RESOURCE FOR ENGINEERS ACROSS MULTIPLE DISCIPLINES IN THE AUTOMOTIVE INDUSTRY!

Automotive Engineering, the flagship magazine of SAE International, is the authoritative source automotive engineers rely on to meet their technology challenges and to design the next generation of vehicles.

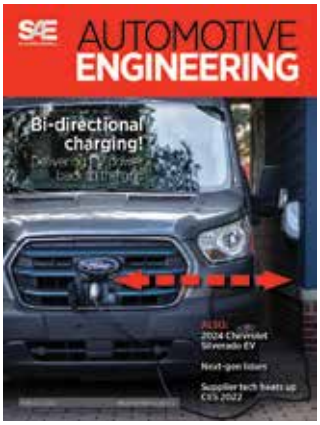
Each month, the *Automotive Engineering* editorial team draws from the most extensive global network of technical contributors and the vast resources of SAE papers and standards to deliver what engineers need to know.

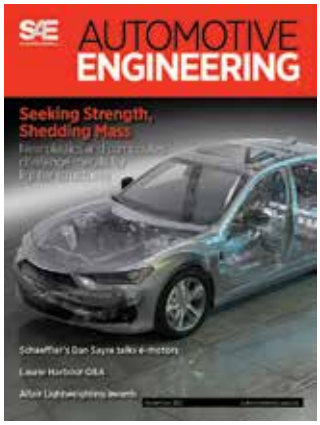
***Automotive Engineering* topics include:**

- Vehicle Electrification
- Lightweighting
- Noise, Vibration & Harshness (NVH)
- Composites & Plastics
- Sensors
- Testing & Simulation
- ADAS/Connected Car
- Advanced Materials
- Software
- Propulsion

Don't miss out on the technology, design trends, and product news that will help you stay informed and up to speed on the newest developments from your competitors, your suppliers, and your industry worldwide.

Start your subscription today at: www.techbriefs.com/subscribe/AUE/SPEACCE23





THE LARGEST-CIRCULATION ENGINEERING MAGAZINE SERVING THE COMMERCIAL VEHICLE MARKET!

Truck & Off-Highway Engineering, SAE's industry-leading magazine for the commercial vehicle market, covers key engineering topics including Commercial Trucks & Buses, On-Highway Engineering, Key Off-Highway Sectors & Technologies, ADAS/Autonomous Vehicles, Defense, Specialty Vehicles and more.

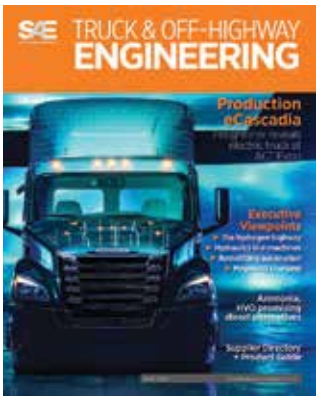
Published 6X annually, *Truck & Off-Highway Engineering's* editorial team draws from the most extensive global network of technical contributors and the vast resources of SAE papers and standards to deliver what engineers need to know.

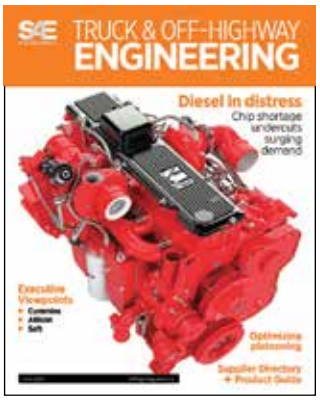
Feature articles in *Truck & Off-Highway Engineering* include:

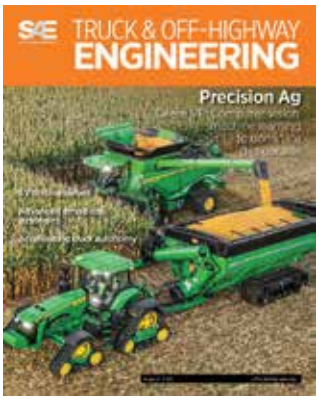
- Diesel Engines & Subsystems
- Battery-Electric & Fuel-Cell Systems
- State-of-the-Art Vehicle Testing
- Advanced Emissions Strategies
- 3D Printing/Additive Manufacturing
- ADAS/Active Safety Systems
- Fluid Power & Motion Control
- Big Data Analytics & the IoT
- Powertrain Management
- Operator Comfort
- Thermal Management Strategies
- Intelligent Machine Control
- Lightweight Material Trends

Don't miss out on the technology, design trends, and product news that will help you stay informed and up to speed on the newest developments from your competitors, your suppliers, and your industry worldwide.

Start your subscription today at: www.techbriefs.com/subscribe/TOH/SPEACCE23







ATTEND THE WORLD'S LEADING AUTOMOTIVE ENGINEERED POLYOLEFINS FORUM - VIRTUAL ON DEMAND AVAILABLE

24TH ANNUAL

TPO® 2023 GLOBAL AUTOMOTIVE CONFERENCE

Troy, MI • October 1-4, 2023

Powered by SPE Detroit Section

ENGINEERED POLYOLEFINS FOR THE MOBILITY EVOLUTION

- LATEST INNOVATIONS FROM INDUSTRY EXPERTS
- NETWORKING WITH ENTIRE SUPPLY CHAIN
- SPONSORED RECEPTIONS
- Caresoft Global - EV BENCHMARKING FACILITY TOUR

WWW. AUTO-TPO.COM

65 TECHNICAL PRESENTATIONS | 4 KEYNOTE SPEAKERS

2 AUTOMOTIVE OEM PANELS | EXHIBITION | EXECUTIVE MARKETING FORUM

PLATINUM SPONSORS

Advanced Composites

Formosa Plastics

GOLD SPONSORS

Alterra Holdings

Carbon Polymers

AMFINE CHEMICAL CORPORATION

ADEKA

AsahiKASEI

BOREALIS Keep Discovering

Braskem

CIMBAR

DOW

ExxonMobil

H.B. Fuller

HAARTZ

KINGFA 金发科技

lyondellbasell Advancing Possible

MAGRIStalc

MITSUBISHI CHEMICAL GROUP

MITSUI PLASTICS, INC.

nexeo plastics

sabic

SIRMAX PROXIMITY COMPOUNDING

SUMITOMO CHEMICAL

EXHIBITORS

Adell

americhem

AUDIA ELASTOMERS

AVIENT

Barentz.

Continental

elastron

ENEOS Materials Corporation

ENTEC

GEON Performance Solutions

Highland Plastics

MIFAB tune in to innovation

Kal-Polymers

KRAIBURG TPE CUSTOM-ENGINEERED TPE AND MORE

MRC

monolith Carbon Black

MYTEX POLYMERS

NOF Corporation

PRET

ATP

SI Group

struktol

WASHINGTON PENN An AUDIA Company

LANYARD SPONSOR

SPARTAN

BREAK SPONSOR

M. HOLLAND

AT THE MONONA TERRACE COMMUNITY AND CONVENTION CENTER

THERMOSET TOPCON

Madison, Wisconsin • April 30-May 1, 2024

Presented by SPE Thermoset Division

THERMOSETS: INITIATING OPPORTUNITIES
FOR NEW PRODUCTS, BUSINESS, TECHNOLOGIES, SUPPLIERS, JOBS/EMPLOYEES, GROWTH & FUN!

CALL FOR PAPERS, SPONSORS & EXHIBITORS



SPONSORSHIP:

- Educates the Industry about the benefits of thermoset composites in numerous applications - The 2023 SPE Thermoset TopCon included 160 registered attendees, 27 sponsors, 2 Keynotes, 20 technical presentations and great networking during 2 breakfasts, 2 lunches and a fun cocktail reception!
- Enables Awards for Research in the field by promising students – The First SPE Thermoset Division **Poster Competition** was launched at the 2022 event.
- Provides **Educational Grants** to Universities to Expand Thermoset Technology Education – A Grant in Honor of Hugh Karraker, Great Grandson of Leo Baekeland, the "Father of Modern Plastic" was awarded to the University of Wisconsin - Madison Polymer Education Center.

- Provides the SPE Thermoset Division valuable resources required to ensure our continued success.

PAPERS:

Thermoset plastics are the most durable, versatile and attractive materials for automotive; air and ground transportation; off-highway equipment; medical; appliance; oil and gas; and a wide variety of other applications where structural integrity, lightweighting, and heat and corrosion resistance are important. Join industry leaders and present your company's latest advancements in thermoset technologies. Technical paper presentations on innovative thermoset plastic materials, processing, manufacturing, testing, sourcing, component design, sustainability and other solutions are encouraged.

Abstracts are due **January 15, 2024** *and final presentations due* **March 15, 2024.** Email abstracts to **intuitgroup@gmail.com.**

The **SPE Thermoset TopCon 2024** will also feature keynotes and exhibits highlighting advances in materials, processes, and equipment for thermoset technologies in multiple applications. The 2-day conference includes networking breakfasts, lunches and a cocktail reception for enhanced collaboration. Social events include golf at University Ridge and a cruise of the Madison shoreline on Lake Monona with deluxe appetizers and beverages offered the day before the conference begins.

SPONSORSHIP OPPORTUNITIES

A variety of sponsorships are available including passes to the conference, exhibit opportunities, and great corporate exposure.

All sponsorships include 10 ft. wide exhibit spaces with a skirted table and chairs, company logo on signage at the event and in conference advertising and company name in publicity.

Breakfast, Lunch and Reception Sponsorships include additional corporate specialty signage, more prominent promotion, and premier exhibit placement at the event.

- **BREAKFAST:** $8,000 includes 4 passes
- **LUNCH:** $9,000 includes 5 passes
- **RECEPTION:** $10,500 includes 6 passes
- **PLATINUM:** $4,500 includes 3 passes
- **GOLD:** $3,500 includes 2 passes
- **SILVER:** $2,500 includes 1 pass

Go to **spethermosets.org/topcon** for more info. For more info on sponsorship, contact Teri Chouinard at **248.701.8003.**

RECEPTION SPONSOR — plenco, PLASTICS ENGINEERING COMPANY

LUNCH SPONSOR — MBI, MAR-BAL, INCORPORATED

BREAKFAST SPONSOR — IDI Composites International, idicomposites.com

BREAKFAST SPONSOR — lyondellbasell, Advancing Possible

AMERICAN COLORS INC. · AOC Trusted Solutions · ATF · CORE Molding Technologies · CIMBAR Performance Minerals · Composites One · GOETTFERT · HUBER · ICT Molding Solutions · INCOA Performance Minerals · INEOS Composites · MP Molding Products · Nabaltec · OMYA · Owens Corning · PENN Compression Molding, Inc. · PREMIX HADLOCK · Zehrco-Giancola Composites, Inc. · Schmidt & Heinzmann · SP2 Carbon · VIBRANTZ Technologies · CW CompositesWorld · Plastics News · Urethanes Technology

SALUTE TO OUR SPONSORS

AUTOMOTIVE COMPOSITES CONFERENCE & EXHIBITION
Novi, MI • September 6-8, 2023
Presented by SPE Automotive and Composites Divisions
WORLD'S LEADING AUTOMOTIVE COMPOSITES FORUM

The SPE Automotive Composites Conference would not exist without the gracious support of our sponsors, who underwrite the cost of facilities and equipment rentals, food and beverages, producing and printing our program guide and conference proceedings, and many other items, large and small. Hence, it is with great appreciation that we thank and acknowledge the contributions of the 2023 Automotive Composites Conference & Exhibition sponsors, exhibitors, and other patrons for making this show a success.

FEATURED SPONSOR & EXHIBITOR

Molding Products

RECEPTION SPONSOR

Institute for Advanced Composites Manufacturing Innovation (IACMI)

PREMIER PLUS SPONSORS & EXHIBITORS

INEOS Composites
Valeo

STUDENT POSTER COMPETITION SPONSOR & EXHIBITOR

Dassault Systèmes

LUNCH SPONSOR

Mitsubishi Chemical Group

COFFEE BREAK SPONSOR

Langzauner GmbH

PREMIER SPONSORS & EXHIBITORS

AOC
Ascend Performance Materials
BASF
BOSTIK Adhesives
BYK USA
Forward Engineering
KATCON Advanced Materials
Westlake Epoxy

ASSOCIATE SPONSORS & EXHIBITORS

3A Composites
CORE MATERIALS
A&P Technology
ATF
Avient
Baylor University PROTOLAB
Baylor University MTACC
Composites One LLC
Datapoint Labs
DIEFFENBACHER
Fagor Arrasate
Fraunhofer Project Centre at Western University
Etablissements Gallois S.A
SP2 Carbon
Huber Engineered Materials
IDI Composites International
Johns Manville
Langzauner GmbH
Michelman
OMYA
PLENCO
Rassini
Schmidt & Heinzmann GmbH & Co. KG
Technical Fibre Products Ltd.
Tangho
Trelleborg Sealing Solutions Albany, Inc.
Vectorply Corporation
Zoltek: A Toray Group Company

TABLE TOP SPONSORS & EXHIBITORS

Celanese
Dassault Systèmes
Institute for Advanced Composites Manufacturing Innovation (IACMI)
MITO Material Solutions
Trimer Technologies

ADVERTISING SPONSOR

DSC Consumables, Inc.

MEDIA / ASSOCIATION SPONSORS

American Composites Manufacturers Association (ACMA)
Automotive Engineering
Additive Manufacturing
Autonomous Vehicle Engineering
CompositesWorld
Gardner Business Media Inc.
Plastics Business
Plastics Decorating
Plastics Engineering
Plastics News
Plastics Technology
Society of Automotive Engineers
Truck and Off-Highway Engineering
Urethanes Technology International
WardsAuto.com