

Composites and Advanced Materials Expo (CAMX 2019)

Anaheim, California, USA
23-26 September 2019

Volume 1 of 2

ISBN: 978-1-7138-6094-5

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2019) by SAMPE
All rights reserved.

Printed with permission by Curran Associates, Inc. (2022)

For permission requests, please contact SAMPE
at the address below.

SAMPE
21680 Gateway Center Drive, Suite 300
Diamond Bar, California, USA
91765-2454

Phone: +1-626-521-9460

www.sampe.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

VOLUME 1

ADDITIVE MANUFACTURING

ADVANCED MATERIALS FOR THERMOPLASTICS

TP19-0728: Microscale Thermal Management and Effect of Defects in Fused Deposition Modeling of Continuous Carbon Fiber PLA Composite	1
<i>Nima Moazami, Massoud Kaviani, Harsh Baid, Reza Hajiha, Cody Godines, Frank Abdi</i>	
TP19-0772: Effect of Surface Treatment of Microfiberlated Cellulose Fibers on Biocomposite Properties and Additive Manufacturing Process	16
<i>Halil L. Tekinalp, Darby Ker, Xianhui Zhao, Bowie Benson, Melanie Buziak, Vlastimil Kunc, William Peter, Soydan Ozcan</i>	
TP19-0784: Prediction of Mechanical Properties of Additively Manufactured Discontinuous Fiber Composites Accounting for Defects and Uncertainties	30
<i>Harsh Baid, Reza Hajiha, Frank Abdi</i>	
TP19-0813: Evaluation of Ultra-Performance Polymers to Use as Thermal Protection Systems for Space Vehicle Application	40
<i>Abdullah Kafi, Hao Wu, Jon Langstron, Ozen Atak, Haewon Kim, Steven Kim, William Fahy, Roderick Reber, John Misasi, Stuart Bateman, Joseph H. Koo</i>	
TP19-0815: Development of Polyamide 6/Polyamide 66 Copolymer Nanocomposite and Its Additive Manufacturability	58
<i>Steven D. Kim, Hao Wu, Joseph H. Koo</i>	
TP19-0829: Characterization of Poss-Ultem Nanocomposites and Their FFF Printed-Part Properties.....	73
<i>Charles M. Davis, Jordan M. Antonson, Paul G. H. Smith, Ben Kaas, John M. Misasi</i>	
TP19-0833: Additive Manufacturing of Polyamide 12 Nanocomposites- Thermal and Mechanical Effects of Varying Infill Levels.....	85
<i>Steven D. Kim, James Grubbs, Kathrin James, Rebecca Millard, Jensen Nance, Hao Wu, Joseph H. Koo</i>	

ADVANCED MATERIALS FOR THERMOSETS

TP19-0656: Laser Sintering of Thermoset Polyimide Composites	100
<i>Kathy C. Chuang, Timothy J. Gornet, Kate Schneidau, Hilmar Koerner</i>	
TP19-0723: Printable Epoxy Core for Hybrid Manufacturing of Composite Sandwich Structures.....	110
<i>Andrew C. Abbott, Gyaneshwar P. Tandon, Hilmar Koerner, Jeffery W. Baur</i>	

CURRENT TECHNOLOGY IN MANUFACTURING AND MATERIALS

TP19-0860: The Construction of a NACA Duct Using Additive Manufacturing Carbon-Composite Materials for a Record Setting Bonneville Streamliner.....	122
<i>Stewart Davis, Burton Brown, David C. Woodruff</i>	

RESEARCH DEVELOPMENTS IN ADDITIVE MANUFACTURING

TP19-0636: Measurement of Robotic Path Deviations and its Influence on Additively Manufactured Components	136
<i>Jan Bremer, Andres Gasser, Johannes Henrich Schleifenbaum</i>	
TP19-0642: Raw Material Characterization of Apparently Similar Rubber Parts Using Multiple Modes of Pyrolysis-GC/MS	149
<i>Rojin Belganeh, Itsuko Iwai</i>	
TP19-0693: Demonstration of Closed Loop Inspection and Repair Using Layer Topographic Mapping with L-PBF.....	164
<i>David Maass</i>	
TP19-0694: Analysis on Part Distortion and Residual Stress in Big Area Additive Manufacturing with Carbon Fiber-Reinforced Thermoplastic using Dehomogenization Technique	178
<i>Seokpum Kim, Harsh Baid, A. Hassen, Abhishek Kumar, John Lindahl, Dylan Hoskins, Christine Ajinjeru, Chad Duty, Pritesh Yeole, Uday Vaidya, Ralph Dinwiddie, Frank Abdi, Lonnie Love, Srdjan Simunovic, Vlastimil Kunc</i>	
TP19-0707: Design for Slicing in Large Format Fused Filament Fabrication	192
<i>Alex C. Roschli, Michael C. Borish, Brian K. Post, Phillip C. Chesser, Jesse J. Heineman, Celeste E. Atkins</i>	
TP19-0758: A Dynamic Mechanical Analysis Approach to Quality Evaluation of Additively Manufactured Continuous Fiber Reinforced Thermoplastics.....	204
<i>Patrick A. Rodriguez, Donald W. Radford</i>	
TP19-0805: Advancements in Short-Fiber Composites VIA Stereolithography.....	219
<i>Patrick G. Simpson, Michael J. Holthaus, Chad A. Ulven</i>	
TP19-0812: A Novel and Fast Method to Qualify and Certify Additively Manufactured Components.....	232
<i>Erin Wernick, Joshua Baker, Sandip Harimker, Ranji Vaidyanathan</i>	

TOOLING

TP19-0742: Large-Scale Reactive Extrusion Deposition of Sparse Infill Structures with Solid Perimeters.....	239
<i>Christopher J. Hershey, John M. Lindahl, Stian K. Romberg, Alex C. Roschli, Ben Hedger, Mike Kastura, Brett G. Compton, Vlastimil Kunc</i>	
TP19-0858: Simulation Assisted Design for an Additively Manufactured Autoclave Tool Accounting for an Anisotropic Expansion	246
<i>A. Hassen, Alexander Lambert, John Lindahl, Dylan Hoskins, Chad Duty, Srdjan Simunovic, Charlie Chin, Victor Oancea, Lonnie Love, Vlastimil Kunc, Seokpum Kim</i>	

UV CURE APPLICATIONS

TP19-0705: 3D Printing of Dual-Cure Benzoxazine Networks	256
<i>Jeremy J. Weigand, Christopher I. Miller, Jared C. Bates, Jeffrey S. Wiggins</i>	

ADVANCES IN MATERIALS

ADVANCED MATERIALS AND SELECTION

- TP19-0692: Fast-Curing Structural Polyurethane Adhesive Increases Manufacturing Throughput 270
Stephen Webb Sr.
- TP19-0794: Allowable Generation and Generic Basis Value for Multiple Loading and Environmental Conditions..... 284
Reza Hajiha, Cody Godines, Angelo De Fenza, Harsh Baid, Elizabeth Clarkson, Nima Moazami, Frank Abdi

FIBERS, TEXTILES, AND REINFORCEMENT FORMS

- TP19-0666: Effect of Tailored Fiber Placement Threads on Carbon/Epoxy Composite Impact Resistance..... 298
Marie-Claude Bélanger, Patricia Forcier, Yohan Gendreau, Alain Bujold, Simon Pesant, Serge Pagé, Louis Laberge-Label
- TP19-0671: Co-Continuous Phase Nanofiber Composites..... 311
Christopher C. Bowland, Eric M. Burgeson, Amit K. Naskar
- TP19-0701: Analysis of the Bending of Tubular Braids on Flexible Mandrels 320
Caroline Collins, Jason Wexler
- TP19-0710: Effect of Sizing on the Interfacial and Mechanical Properties of Carbon Fiber (CF) Reinforced Polyamide (PA6,6) Composites..... 335
Muhammad Iqbal, Brandon Gregoire, Nagesh Potluri, Steve Bassetti
- TP19-0729: Short Milkweed Floss Fiber as Efficient Natural Reinforcement for Polymeric Materials..... 349
Pierre Ovlaque, Marie Bayart, Saïd Elkoun, Mathieu Robert

MULTIFUNCTIONAL MATERIALS & STRUCTURES

- TP19-0720: Composite Hinge Structures with Variable In-Plane Stiffness 361
Colin Rowbottom, Lauren A. Moore, Daniel M. Baechle
- TP19-0747: Replacing Metal-Based Lightning Strike Protection Layer of CFRPS by 3D Printed Electronically Conductive Polymer Layer..... 376
Vipin Kumar, Tyler Smith, Justin C. Condon, Pritesh S. Yeole, A. Hassen, Vlastimil Kunc
- TP19-0787: Polyimide Nanocomposites with Remarkable Rubbery Plateau Modulus and Outstanding Coating Resistance 384
Jude O. Iroh, Jimmy Longun
- TP19-0802: Performance Prediction of Structural Capacitors Under Mechanical, Thermal and Environmental Loading Conditions..... 394
Rauhon Ahmed Shaik, Vamsee Vadlamudi, Rahman Jani Mazed, Deepak Shantaram Pisal, Rassel Raihan, Kenneth Reifsnider

NANOMATERIALS & NANOTECHNOLOGY

- TP19-0756: Roles of Carbon Nanofiber Alignment and Concentration for the Improvement of Z-Directional DC Electrical Conductivity of CNF Z-Threaded CFRP Laminates Manufactured Using a Radial Flow Alignment Technique 409
Bikash Ranabhat, Sebastian Kirmse, Kuang-Ting Hsiao
- TP19-0773: A Preliminary Study of the Electrical and Interlaminar Shear Properties of a Porous CFRP Composite Laminate Containing Carbon Nanofiber Z-Threads 420
Sebastian Kirmse, Bikash Ranabhat, Kuang-Ting Hsiao

RESINS & MATRICES

- TP19-0638: An Out-of-Autoclave Toughened Epoxy Prepreg System Curable at Different Curing Temperatures 435
Henry S. Villareal, Riley Harden, Frank W. Lee
- TP19-0706: Pre-Cured Epoxy Amine Microparticles with Tailored Reactivity for the Study and Control of Matrix Formation 451
Travis C. Palmer, Jordan J. Winetrout, Bernardo L. Barea-Lopez, Jeffrey S. Wiggins

THERMOPLASTIC MATERIALS & APPLICATIONS

- TP19-0715: 3-Point Bending Impact Test of Carbon Fiber Reinforced Thermoplastic Composites 465
Fumiaki Yano, Yuki Kamei, Tsuyoshi Matsuo
- TP19-0800: Cost Effective Thermoplastic Composites in Aerostructures 474
Corbin Chamberlain, David Leach, Trevor McCrea

THERMOSET MATERIALS & APPLICATIONS

- TP19-0672: Epoxy Resins for Downhole Composites: Breaking the Performance – Processability Paradigm..... 490
Prashanth Badrinarayanan, Huifeng Qian, Tyler Runk
- TP19-0680: Modified Acrylic Resin for Low Flame Spread/Low Smoke Applications with Improved Processing 504
Michael G. Stevens, John Brandenburg, Benito Rodriguez
- TP19-0697: Trenchless Pipe Rehabilitation: An Overview of Resin Alternatives to Meet Industry Needs..... 513
Olivia E. Watkins
- TP19-0704: Pre-catalyzed Anhydride Curing Agents for High Performance Epoxy Pultrusion Applications..... 524
Alejandrina Campanella, Michael Watkins, Karana Shah
- TP19-0708: Advances in Weatherable Sheet Molding Compound Technology 536
Joseph R. Amlung, Jonathan M. McKay, Thomas J. Skelskey
- TP19-0709: Mechanical Property Enhancement Prediction of Matrix Materials for Wind Turbine Blades 546
Sagar Shah, Mohammad Hashim, Alireza Amirkhizi, Christopher Hansen, Marianna Maiaru

TP19-0775: Development of Nanocomposite Thermoset Ablative for High Heat Flux Applications	556
<i>William P. Fahy, Joseph H. Koo, Dana Misasi, Luke Canan, Ruby Para, Kara Li</i>	
TP19-0810: Weatherable Molded-in-Color Composites: Mechanisms and Relationships of Accelerated Test Methods and Geometry.....	569
<i>Santosh K. Yadav, Paul A. Rettinger</i>	
TP19-0851: High Performance, Low Cost, Discontinuous Fiber Molding Compound Based on Reclaimed Carbon Fiber-Epoxy Prepreg.....	582
<i>Pete George, Benjamin Rutz, Felix Nguyen, Toshiya Kamae</i>	

BONDING & JOINING

COMPOSITES TO COMPOSITES

TP19-0634: Overmolding Technology Applied for Structural Aeronautical Applications	595
<i>Gilles Andrieu</i>	
TP19-0645: Effect of Heat Damage on the Double Lap Joint Strength of Pultruded E-glass/Polyester Composites	614
<i>Abdalla Alomari, Alexander B. Morgan, Donald Klosterman, Elias A. Toubia</i>	
TP19-0653: Testing and Analysis Correlation of Composite Sandwich Longitudinal Bonded Joints for Space Launch Vehicle Structures	634
<i>David W. Sleight, Arunkumar Satyanarayana, Brian H. Mason, Babak Farrokh, Kenneth Segal</i>	
TP19-0661: Predicting Failure of Woven Composite Laminates	650
<i>Daniel C. Munden, Arunkumar Satyanarayana, David W. Sleight</i>	
TP19-0663: Manufacturing Process Development for Adhesively Bonded Joints in Large-Scale Space Structures	665
<i>William E. Guin, James R. Newton, David E. Lawrence, Phillip D. Thompson, Andrew N. Martin, Casey C. Wolfe, Justin R. Jackson, Sandi G. Miller</i>	
TP19-0696: Composite Repair Process for Adhesively Bonded Joints.....	680
<i>Sarah B. Cox, Susan E. Danley, J. Ranae Wright, Alan T. Nettles, William E. Guin, Kenneth N. Segal</i>	
TP19-0727: How Advanced Composite Materials Respond to Surface Treatment.....	695
<i>R. Giles Dillingham, Brooke Campbell, Elizabeth Kidd</i>	
TP19-0736: 3D Woven Composite End Ring for SLS Class Structures: Tool Design, Manufacturing, and Characterization	704
<i>Benjamin A. Dietsch, Karl M. Gruenberg, Michael D. Rauscher, Thomas J. Margraf, Kenneth N. Segal</i>	
TP19-0744: 3D Woven Composite End Ring for SLS Class Structures; Design Development, Manufacturing and Verifications.....	717
<i>Kenneth Segal, Babak Farrokh, David Sleight, Robert Matarese, David Paddock, Robert Allen, Hakan Gokce, Leon Bryn</i>	
TP19-0836: Nanomechanical Property Characterization of Adhesive Bondlines	732
<i>Austin C. Zukaitis, Rita J. Olander, Brian D. Flinn</i>	

TP19-0842: Sensitivity Analysis of Induction Welding Process Variables..... 745
Kerrick Dando, Mark Wadsworth, Matt Bickhard, Michel van Tooren, Jaspreet Pandher

TP19-0848: Connections and Structural Applications of FRP Composites for Civil Infrastructure:
A Review with Own Practices..... 756
Hai Fang, Weiqing Liu, Ruili Huo, Yujun Qi, Jun Wang

JOINING SIMULATION

TP19-0646: Uniaxial Tensile Properties of AS4 3D Woven Composites with Four Different Resin
Systems: Experimental Results and Analysis-Property Computations..... 780
*Babak Farrokh, Kenneth N. Segal, Trenton M. Ricks, Sandi G. Miller, Benjamin T. Rodini,
David W. Sleight*

VOLUME 2

MULTI-MATERIAL

TP19-0834: Multi-Material Bonding Solid-State Bonding Via Bond Exchange Reactions..... 795
Jacob L. Meyer, Pixiang Lan

DESIGN, ANALYSIS, AND SIMULATION

ADVANCED DESIGN METHODS

TP19-0675: Lightweighting Capability and Design Guidelines for Continuous Fiber Tow
Reinforced Hybrid-Molded Composite Structures 810
Justin D. Miller, Joshua S Dustin, Jan-Anders E. Mansson, Patrick Blanchard, Jeffrey Dahl

TP19-0771: Automation of Quality Assurance of Numerical Control Data using Knowledge Based
Engineering Applications 822
Tory R. Whitcomb, Donald J. Hinson, Karin E. Cowdrey, Frank P. Wiesner

TP19-0776: Automating Composite Design Through Knowledge Based Engineering Applications 835
Bruce E. Gabel

ADVANCED DESIGN, ANALYSIS, AND VERIFICATION

TP19-0702: Design of Advance Composites for Vehicle Front End Energy Management &
Optimized Performance of Bumper Beam 844
*Praveen Kumar, Ayan Chakraborty, Velmurugan R, Balasubramanian M, Shankar
Venugopal, Akella Sarma*

TP19-0734: Modified Short Beam Shear Testing Methodology for Pultruded Unidirectionally
Reinforced Composite Rods..... 859
Yves Cordeau, Fayaz J. Ali, Lei Zhao, Mac Puckett

TP19-0763: Simulation of a Laminar Flow Model to Enable Design for Manufacturing of Laminar
Flow Aerostructures 868
Eddie Irani, See-Ho Wong, See-Cheuk Wong

TP19-0783: Lightning Strike Testing on Integrally Stiffened Stringer Panels..... 880
J. Andrew Baker, Brian Kitt

TP19-0817: Influence of Void Content on the Dielectric Permittivity of 3D Printed Parts	894
<i>Nikolas U. Manos, Christian C. Alindayu, Mark Peyron</i>	
TP19-0818: Part Performance of FDM printed Nylon 12CF Bracket for Cost-Effective Ground Support Equipment.....	906
<i>Reza Hajiha, Kurt Reichelderfer, Harsh Baid, Cody Godines, Frank Abdi</i>	
TP19-0820: Fast and Accurate Design Analysis for Fiber Placement Process	921
<i>Yvan Blanchard</i>	

COMPUTATIONAL MATERIALS SCIENCE AND ENGINEERING (CMSE)

TP19-0786: Computational Modeling of Polymer and Carbon Fiber Composite Interfaces.....	931
<i>Mohammad Atif Faiz Afzal, Andrea R. Browning, Jeffrey Sanders, Thomas J. Mustard, Mathew D. Halls</i>	
TP19-0859: Modeling Transversal Support from Nanofiber Z-Threads to a Carbon Fiber by Finite Element Analysis of a CFRP Unit Cell	942
<i>Keonhyeong Kim, Kuang-Ting Hsiao</i>	

DAMAGE, FATIGUE, AND FRACTURE

TP19-0626: Master Paris Law for Thermal Fatigue of Laminated Composites.....	957
<i>Ever J. Barbero, Javier Cabrera Barbero</i>	
TP19-0752: Modeling and Simulation of Polymer Composite Prepreg Forming Process	966
<i>Robert Meinders, Shouvik Ganguly, K. Chandrashekhara</i>	

PROCESS MODELING & SIMULATION

TP19-0740: Warpage Predication of Continuous Fiber Reinforced Thermoset or Thermoplastic Composite Using a Multi-Scale Modeling	978
<i>A. Cheruet</i>	
TP19-0754: Multiphysics Prediction Model of Microwave Curing for Thick Polymer Composites	989
<i>Siva Dasari, Manoj Rangapuram, K. Chandrashekhara, Nagaraja Iyyer, Nam Phan</i>	
TP19-0761: Manufacturing-Informed Performance of Prepreg Platelet Molding Compound	1004
<i>Anthony J. Favaloro, Benjamin R. Denos, Drew E. Sommer, Rebecca A. Cutting, Johnathan E. Goodsell</i>	
TP19-0806: Digital Twinning of an Automated Fabric Draping Process for Industry 4.0 Applications: Part I-Multi-Body Simulation and Finite Element Modeling.....	1017
<i>Hossein Montazerian, Reza Sourki, Milad Ramezankhani, Armin Rashidi, Marian Koerber, Abbas S. Milani</i>	

USE OF COMPOSITES WITH METAL, CERAMICS, ETC.

TP19-0659: Cold Spray Deposition of Aluminum onto Polymer and Composite Substrates	1027
<i>Po-Lun Feng, Reza Rokni, S. Nutt</i>	

GREEN & SUSTAINABILITY

DESIGNING FOR SUSTAINABILITY

- TP19-0831: A Sustainable and Durable Glass Reinforced Thermoplastic Composite Railroad Crosstie..... 1042
Mohamed Selim, Matt Moore, Jong Lee, Alexis Green

RECYCLING OF COMPOSITES

- TP19-0762: Chemical Recycling of Amine/Epoxy Composites at Atmospheric Pressure: Fiber Recovery and Matrix Reuse 1053
Yijia Ma, Travis J. Williams, S. Nutt

RENEWABLE & BIO-COMPOSITES MATERIALS

- TP19-0780: Thermo-Mechanical Characterization of HDPE-Tobacco Lignin Blends 1068
Samsul Mahmood, Irfan Tahir, Venkatagireesh Menta, Alexey Kacharov, Sergiy Yemet

MANUFACTURING & PROCESSING TECHNOLOGIES

ADVANCES IN AUTOMATION & AFFORDABLE MANUFACTURING

- TP19-0658: Recent Advances in Artificial Intelligence Applications to Composites Fabrication..... 1081
Scott Blake
- TP19-0681: An Investigation of High-Speed Consolidation of Carbon Fiber – Epoxy Composites Through Ultrasonic Welding 1089
David Hoskins, Genevieve Palardy
- TP19-0716: Automated Composite Ply Kitting and Pre-Forming..... 1102
Jens de Kanter
- TP19-0767: Advances in a Next Generation Measurement & Inspection System for Automated Fibre Placement 1116
Marc Palardy-Sim, Maxime Rivard, Guy Lamouche, Steven Roy, Christian Padioleau, André Beauchesne, Daniel Levesque, Louis-Guy Dicaire, Jonathan Boisvert, Shawn Peters, Jihua Chen, Marc-André Oceau, Julieta Barroeta Robles, Jay Hissett, David Swope, Stephen Albers, Robert Harper, Ken Wright, Brad Buhrkuhl, Marcus Klakken, Gil Lund, Ali Yousefpour
- TP19-0826: Development of a Techno-Economic Model to Explore Wind Blade Manufacturing Options 1129
Stephen B. Johnson, Matteo J. Polcari, James Sherwood

COMPOSITE MANUFACTURING & PROCESSING

- TP19-0644: Novel Composite Fabrication Methods for Engine Strut AFT Fairing Assemblies 1143
Kevin Robbins, Steve Crouch, Eugene Manchur, Richard Cole, Ali Yousefpour, Marc-André Oceau, Marc Palardy-Sim, Trevor Bartkiewicz, Andrew Kosie, Goran Fernlund, Christophe Mobuchon, Chris Marek, Fred Doern, Yann Couture, Nick Cichine, Alastair McKee, Laura Petrescue, Jason Shim

TP19-0741: Application of Open Reed Weaving Technology for Production of Low Waste Multiaxial Fabrics.....	1158
<i>Yanick Schlesinger, Philipp Huber, Thomas Gries</i>	
TP19-0750: Process Mapping for Defect Control in the Adhesive Bond-Line of Co-Cured Honeycomb Core Sandwich Structures	1168
<i>Daniel Zebrine, Timotei Centea, Mark Anders, S. Nutt</i>	
TP19-0751: An Investigation of Laser Repass Annealing of LATP Processed CF/Peek Properties.....	1181
<i>A. Chanteli, R. M. O'Higgins, J. P. Canart, P. M. Weaver</i>	
TP19-0777: The Design, Analysis and Testing of an Advanced Cascade Design	1191
<i>Henry A. Schaefer, Mark A. Wadsworth</i>	
TP19-0793: Mechanical Properties of Continuous Carbon Fiber Reinforced Thermoplastic Composites	1206
<i>Samuel D. Strassler, Connor J. Reddington, Patrick A. Rodriguez, Donald W. Radford</i>	
TP19-0797: Leveraging Modern Resin Technology for Shop Efficiency Improvements	1217
<i>Kevin R. Lambrych, Lisa M. Adkins, Achille Bivigou Koumba</i>	
TP19-0847: Light Weight Reinforced Thermoplastic Composites with New Design for Recreational Vehicles.....	1225
<i>Liqing Wei, Ruomiao Wang, Mark O. Mason</i>	

FORMING TECHNOLOGIES

TP19-0768: Method for Eliminating Radius Wrinkles and Bridging in Composite Laminates	1238
<i>Mark A. Wadsworth, Joseph P. Heil, Nicholas Cairns</i>	

OUT-OF-AUTOCLAVE (OOA)

TP19-0770: Effect of Fiber Bed Architecture on Single Resin Droplet Spread for Prepreg Manufacturing	1250
<i>Patricio Martinez, Bo Jin, S. Nutt</i>	
TP19-0825: Unique Polyaryletherketone (PAEK) Prepreg Allows High Versatility in Composite Parts Manufacturing using Automated Lay-up.....	1264
<i>Justin Merotte, Gilles Larroque, Stuart Green, Didier Padey, Victorien Merle, Denis Cartié, Alexandre Hamlyn</i>	

PROCESS CONTROL

TP19-0637: Crystal Morphology and Bending Modulus Uniformity of Polyetheretherketone in Thick Compression-Molded Parts	1282
<i>Ruaa Al-Mezrakchi, Terry Creasy, Hung-Jue Sue, Tim Bremner</i>	
TP19-0668: In-Situ Monitoring and Control of Induction Welding in Thermoplastic Composites Using High Definition Fiber Optic Sensors.....	1297
<i>Nur Aida Abdul Rahim, Jaspreet Pandher, Nicholas Coppola, Vivek Penumetsa, Michel van Tooren</i>	

RAPID CURE & MANUFACTURING PROCESSING TECHNOLOGIES

- TP19-0733: Fast Cure of Vacuum Bag Only Prepreg Composites 1312
David B. Bender, Timotei Centea, S. Nutt

RESIN INFUSION/LIQUID MOLDING/VARTM COMPOSITES PROCESSING

- TP19-0712: Characterization and Validation of In Situ Void Formation During Resin Infusion 1327
Andrew R. George, Wyatt Y. Warner
- TP19-0832: PreForm Developments For Resin Infusion for Rapid High-Performance Molding (RAPM) for Small Parts 1342
Thomas K. Tsotsis, Gilbert Cespedes-Gonzalez, Mario Wiener, Manuel Frank, Leslie Cohen, Dominic Calamito, Gail L. Hahn
- TP19-0855: Effect of Curing Temperature on the Fundamental Properties of Laminated Composites Fabricated Using Plain Weave and Non Crimp Fiber and Epoxy Resin..... 1358
Vishwas S. Jadhav, Ajit D. Kelkar

TOOLING

- TP19-0857: Newly Developed Casting Alloys of Low Thermal Expansion with High Yield Strength for CFRP Molding Dies 1369
Kotaro Ona, Haruyasu Ohno, Naoki Sakaguchi, Shin Utsunomiya

MARKET APPLICATIONS

AEROSPACE

- TP19-0698: Developing a Hybrid PAEK Overmolded Thermoplastic Composite Bracket..... 1378
Frank J. Ferfecki, Tyler Smithson, Chris Bierregaard
- TP19-0845: Characterization of Epoxy-Nanoparticle Composites Exposed to Gamma & UV Radiation for Aerospace Applications..... 1396
Mauricio Torres, Edgar A. Franco-Urquiza, Pedro González-García, Jorge Bárcena-Balderas, Saúl Piedra, Tomás Madera, Rodrigo Meléndrez, Patricia Quintana

INFRASTRUCTURE/CONSTRUCTION

- TP19-0801: Worldwide Overview of Composite Applications for Waterway Infrastructure 1405
Ruifeng R. Liang, Hota VS GangaRao, Yingxiang Lu, John D. Clarkson

NON-DESTRUCTIVE EVALUATION & MATERIALS TESTING

NON-DESTRUCTIVE INSPECTION & MATERIALS TESTING

- TP19-0639: Developing a Procedure for Prepreg Tack Characterization 1418
Edwin J. Smith, Cecile Grubb, John Misasi, Nicole Larson

TP19-0650: Influence of Sample Preparation, Fiber Orientation and Deformation Mode on Dynamic Mechanical Response of a Carbon-Fiber-Reinforced Composite.....	1430
<i>Alexander Klutz, Alexander Troiss, Gunther Arnold</i>	
TP19-0657: Quantitative Interfacial Adhesion Between Glass Fibers and Epoxy Resin with Dopamine Using a Microdroplet Pull-Out Test and AE Measurement	1438
<i>Joung-Man Park, Pyeong-Su Shin, Jong-Hyun Kim, Yeong-Min Baek, Ha-Seung Park, K. Lawrence DeVries</i>	
TP19-0665: Non-Destructive Production Line Structural Evaluation	1447
<i>Geoffrey E. Clarkson</i>	
TP19-0674: Quantitative Comparison of Close-Proximity and Large-Standoff Thermography for Nondestructive Inspection of Carbon Epoxy Composites	1460
<i>Maria F. Beemer, Steven M. Shepard</i>	
TP19-0682: Internal Strain Monitoring of CFRP Laminates During Moisture Absorption/Desorption Using Distributed Optical Fiber Sensors	1472
<i>Kazunori Takagaki, Kazushi Sekine, Shu Minakuchi</i>	
TP19-0721: Analysis of Fiber Orientation and Distribution of Volumetric Strain in Polyamide 6-Glass Fiber Composites Using Cylinder Correlation and Digital Volume Correlation Methods	1483
<i>S. Ali Shojaee, Lucien Laiarinandrasana, Thilo Morgeneyer, Lukas Helfen, Kamel Madi</i>	
TP19-0746: In Situ Thermal Inspection of Automated Fiber Placement Manufacturing.....	1491
<i>Peter D. Juarez, Elizabeth D. Gregory, K. Elliott Cramer</i>	
TP19-0760: Algorithm to Enhance Signal to Noise Ratio of Peel Ply at the Bondline of Out-of-Autoclave Composite Assemblies	1503
<i>Gary S. LeMay</i>	
TP19-0808: Fatigue Performance of Carbon Fiber Reinforced Nanosilica Modified Epoxy Composites	1517
<i>J. S. Tate, O. K. Arigbabowo, Shree Swayam, Roger Faria</i>	
TP19-0816: Non-Contact Ultrasonic Quality Analysis of Large Finished Aerostructures	1533
<i>Anuj M. Bhardwaj, Kashyap C. Patel, Whitney J. Moon</i>	
TP19-0861: Application of Serial X-Ray Scattering for Microstructure Optimization of Polyacrylonitrile Fibres Produced by Wet Spin Processing	1544
<i>David Fox, Anthony Pierlot, Jasjeet Kaur, Linda Hillbrick, Claudia Creighton, Peter Lynch</i>	

SENSORS & SENSOR TECHNOLOGIES

TP19-0647: Automated Precision Thickness Inspection of Composite Parts	1555
<i>Mark D. Haynes, Glen P. Cork</i>	
TP19-0835: NDE Thermal Mapping Using Thermochromic Sensor Films	1566
<i>Tiffany F.L. Tang, Ryan E. Toivola, Sei-Hum Jang, Paul G. Vahey, Catherine A. Baker, Eric G. Winter, Emerson McNamee, Alex K.-Y. Jen, Brian D. Flinn</i>	

Author Index