CAMX

THE COMPOSITES AND ADVANCED MATERIALS EXPO

2017 CAMX POSTER SESSION

AWARD AND AUTHOR MEET-AND-GREET

OCCC – EXHIBIT HALL – X78
WEDNESDAY, DECEMBER 13
2:00 PM – 4:00 PM

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CAMX
THE COMPOSITES AND ADVANCED MATERIALS EXPO

CAMX is pleased to have the participation of the next generation of researchers, engineers and industry professionals in the 2017 CAMX Poster Session. Browse poster displays throughout CAMX to see which universities and organizations are pioneers of composites research and how their advancements may impact business. Posters are judged on overall presentation, significance to the advancement of composites and advanced materials, and commercial applications.

The Poster Session winners will be identified with ribbons on Wednesday morning, December 13, 2017.

Thank you to all who submitted!

ENTRY PS17-0008
Green Concrete - Concrete without Chloride Limit

Concrete is the single most widely used material in the world, however, it is not an environmentally friendly product. It consists of freshwater, fine and coarse aggregate mostly derived from non-renewable natural resources and cement which its production contributes 5% of the annual global CO2. My research aims at utilizing seawater, recycled aggregate, and cement kiln dust as sustainable alternatives in combination with GFRP reinforcement for concrete production.

University of Miami, Seyedmorteza Khatibmasjedi, Antonio Nanni

ENTRY PS17-0010
Thermal, Fire Retardancy, and Biodegradability Properties of PHBV/ HNTs Bio-Nanocomposites

Environmentally friendly biopolymer was used in this study as a potential replacement of the conventional petroleum-based polymer for the automobile application.

Tuskegee University, S. M. Hasan, Shaik Zainuddin, Mohammad Uddin

ENTRY PS17-0013
Adhesive Layer Damage Detection in Concrete Strengthened with Composite Laminates

Triboluminescent materials are being researched as damage sensors in composites since 1999. The study presented in this poster uses the triboluminescent phenomenon by combining it with PMMA based optical fibers that act as the transport medium for the luminescence, to detect debonding in concrete structures externally bonded with carbon fiber laminates. The study shows that these novel sensors are capable of detecting micro and major cracking in the adhesive layer in real-time. When fully developed, they will provide a novel method for health monitoring in civil as well as aerospace industry.

FAMU-FSU College of Engineering, Kunal Joshi, Marquese Pollard, Andrea Chiari, Tarik Dickens

ENTRY PS17-0015
Effect of Applied Consolidation Pressure in Direct Digital Manufacture of Continuous Fiber Reinforced Composites

The current effort focuses on assessing the effects of adding the application of controlled, mechanical pressure as a tune-able parameter in the direct digital manufacture of continuous fiber reinforced thermoplastic matrix composites. Mechanical and metallographic evaluations are utilized to assess the effectiveness of applied consolidation pressure as a tune-able process parameter during the printing process. Samples exposed to applied consolidation pressure during processing exhibited short-beam strength values in excess of 27 MPa, in addition to fiber volume fractions as high as 52.5%, coupled with void volume fractions as low as 2.4%.

Colorado State University, Patrick Rodriguez

ENTRY PS17-0016
Geometrically Complex Continuous Fiber Reinforced Composites Manufacturing through the Development of a 5-axis 3D Printer

In order to overcome the limitations that led to planar, layer wise direct manufactured continuous fiber reinforced composites, and increase design flexibility, a 5-axis continuous fiber capable additive manufacturing system has been developed. The addition of 2 axes placed on the head of a traditional 3 axes gantry system is necessary to maintain reinforcement placement head orientation with respect to the changing surface contour and fiber path over complex contours. In order to place fiber on concave and convex surfaces the 5-axis system has been designed to place fiber onto tooling with included angles ranging from flat to 45 degrees.

Colorado State University, Mark Bourgeois

ENTRY PS17-0022
Comparative Study on the Ice Failure Criteria Using Interface Modeling Technique

This research is about prediction of failure characteristic and fracture behavior of ice material and its application for arctic engineering research. The ice material can be described as a kind of composite material model, but it is not easy to describe a failure mode because of ice has very different mechanical properties in each ocean site. Now, an application of ice material in offshore industry is being to apply to design the hull structure of offshore platform, which is affected by freezing effects in arctic ocean.

Korea Research Institute of Ships and Ocean Engineering, Kangsu Lee, Doyoub Kim, Hyun-seok Kim, Byoungjae Park, Dongho Jung

ENTRY PS17-0025
High Performance Carbon Nanotube - Silver Matrix Composite

Carbon nanotube (CNT) has stimulated research in many fields of study due to its wide application as a result of its high strength to weight ratio as well as outstanding transport properties. Although most researchers have focused on using CNTs to reinforce polymeric and ceramic matrices for composite applications, CNT reinforced metal matrix composites are quickly emerging as attractive materials in the process of combining CNTs' lightweight, superior strength and stiffness and high conductivity with potential applications in aerospace, electrical and automotive industries. This research is an attempt to use entangled carbon nanotube network (buckypaper) as reinforcement in metal matrix (silver). Impregnation of metals with CNTs achieved through the metals into the carbon nanotube networks via metal infusion, sonication and filtration processes. Scanning electron microscopy (SEM) and transmission electron microscopy (TEM) were used to evaluate CNT dispersion properties. Thermogravimetric analysis was used to calculate the percent of silver and CNT in the resultant composites. Four point probe was used to measure the resistivity and conductivity of the composites and Laser Flash Apparatus were used to estimate thermal conductivity of the CNT/Ag composite. The results show impregnation of metals with CNTs through sonication and filtration and processes which led to significant increase and improved properties of the composite when compared with the silver and CNT individually.

High Performance Material Institute / Florida A&M University, Abiodun Oluwalowo

ENTRY PS17-0026
Damage Monitoring in Trailing Edge Bondlines of Wind Turbine Blades with Triboluminescent Sensors

Trailing edge joints in wind blades are prone to damage due to the higher intensity stress concentrations. If not detected early, cracks or disbonds in trailing edge might propagate rapidly resulting in catastrophic failure of the whole blade. This article utilizes the novel In-situ Triboluminescent Optical Fiber (ITOF) sensors for damage monitoring in adhesively bonded composite joints. The results show that the triboluminescent (TL) emissions occur at the onset of damage in real-time on adhesively bonded composite panels of different adhesive thicknesses. The TL response increases with the increase of the fracture toughness of adhesive joints.

High Performance Material Institute / Florida State University, Md Abu Shohag, Taniwa Ndebele, Okenwa Okoli
University of Colorado, Scott Tran

ENTRY PS17-0027
Characterizing Hybrid Carbon Fiber Reinforced Polymer Composites Using Piezospectroscopy and Digital Image Correlation

Hybrid carbon fiber reinforced polymer composites with alumina nanoparticles improves material properties and allows the determination of the dispersion of alumina and mechanical properties using the photoluminescence property of the embedded alumina. Reactive and non-reactive silane coupling agents treated nanoparticles were dispersed within the composite in 6, 9 and 12 weight percentages. A portable piezospectroscopy system was used to test the samples for dispersion and mechanical properties along with digital image correlation during a uniaxial tensile test. Piezospectroscopic contour plots show the dispersion of alumina nanoparticles at the surfaces and provide stress maps at different loading conditions.

University of Central Florida, Sanjida Jahan, Seetha Raghavan
Imperial College London, Declan Carolan, Ambrose Taylor

ENTRY PS17-0028
Carbon Fiber-Carbon Nanotube Multiscale Composites – The Key to Multifunctionality

A polymer reinforced with carbon fiber (CF) grafted with carbon nanotubes (CNTs), referred to as multiscale composite is a promising candidate for a multifunctional material. We present a novel approach to grow CNTs directly on the CF employing chemical vapor deposition. We aim to overcome a detrimental effect of CNT growth on CF mechanical properties. We explore alternative catalyst configurations using iron and nickel pre-delivered on the CF surface as well as the delivery of an evaporated iron catalyst. We examine the diffusion of metallic nanoparticles into CF using focused iron beam, scanning electron microscopy and energy-dispersive X-ray spectroscopy.

FHNW, Institute of Polymer Engineering, Wojciech Szmyt, Clemens Dransfeld
TUHH, Institute of Polymer and Composites, Katharina Kröning, Bodo Fiedler

ENTRY PS17-0029
An Integrated Multi-Physics Processing Model for Predicting Residual Stress in Fiber-Reinforced Composites

The goal of this project is to develop a processing model that predicts the residual stress development in composites during the VARTM process. A flow model is developed to simulate the infusion process, in which the dry carbon fiber is wetted by the resin driven by the pressure difference, through coupling the flow model and compaction model. The flow model is followed by decoupled thermal-mechanical analysis to compute residual stress accumulation. The accuracy of the model is assessed by comparing the warpage curvatures of non-symmetric laminate manufactured in our lab to that predicted by the numerical model.

University of Connecticut, Weijia Chen, Dianyun Zhang

ENTRY PS17-0032
Study on Jacket Design for Offshore Platform considering Optimization of Structural Material and Topology

Design of jacket structures for offshore platforms is complicated by the need to assess structural safety and up-front cost. A well designed jacket structure with optimized structural material and topology contribute to the structural integrity and reliability of an offshore platform. In this research, the geometry of the jacket is determined in accordance with the classification rules and general jacket design process. And braces are designed through the study of the topology optimization of the jacket structural material. This jacket design process and safety evaluation can be effective the total design cycle and increasing the reliability of the final structure.

Korea Research Institute of Ships and Ocean Engineering, Doyoub Kim, Byoungjae Park, Hyun-seok Kim, Kangsu Lee

ENTRY PS17-0033
Design of Auxetic & Hybrid Honeycomb Structures for Energy Absorption Applications

The poster shows the current problem in the most desirable honeycomb structures (their in-plane properties) and how it can be improved. The new design auxetic-strut design and the hybrid designed are shown with their in-plane and out-of-plane compressive properties. The tests were carried out on 3D printed samples and the results were validated using finite element analysis. The new introduced structures show excellent compressive properties under in-plane and out-of-plane directions. The collapse mechanism of the structures are also explained. These structures give a new insight on designing new cellular structures and how to tailor their properties.

High Performance Material Institute / Florida State University, Aniket Ingrole, Ayou Hao, Richard Liang

ENTRY PS17-0034
The Implementation of Natural Fibers and Bio-Based Resins into Roofing Materials

The needs for affordable, durable, and safe housing vary considerably around the world based on factors such as available resources and production methods. A prevalent obstacle to durable and safe housing is a lack of low-cost and renewable roofing material that utilizes local resources and provides satisfactory performance over time under varying adverse conditions. Researchers at North Dakota State University integrated flax fiber and bio-based resins into a housing shingle to develop roofing with similar or superior properties when compared with synthetic counterparts.

North Dakota State University, Aaron Kinslow, Carrera Horton, Sarah Whims

ENTRY PS17-0037
Low Cost Carbon Fibre Precursors by Using Inorganic Solvents

PAN fibers for textile and technical applications represent a big market with good future prospects. In Europe and China the producers will have to meet strict regulations regarding the use of harmful chemical substances. In other countries similar approaches are considered. These political interferences mean extra investments for the producers concerned in the first place, but the regulations do not have to be of disadvantage for the producers in the longer term. Better fiber properties at similar or even lower production costs are attainable. Besides, these solvents are advantageous in regard to health protection of the workers and environmental effects.

ITA of RWTH Aachen University, Stefan Peterek, Thomas Gries

ENTRY PS17-0039
Determination of Material Properties for ANSYS Progressive Damage Analysis (PDA) of Laminated Composites

This poster presents required material properties to predict damage on E-Glass Epoxy laminated composites using ANSYS with Progressive Damage Analysis method. The results show the comparison between experimental data and predicted data using ANSYS. Also, there is an example that shows damage contour plot of an open-hole E-Glass Epoxy laminated composite that is made by ANSYS using the optimized material properties in this study.

West Virginia University, Mehdi Shahbazi, Ever Barbero

ENTRY PS17-0040
Thermoplastic Coating of Glass Fibres

A new production of glass fibre reinforcement thermoplastic is presented. Polyamid 12 powder is first blown at a single glass filament while the Spinning process. In a second step the powder is melted on the glass filament surface. The last step is the winding of the thermoplastic coated glass filament.

ITA of RWTH Aachen University, Robert Brüll, Alexander Lüking, Davide Pico, Thomas gries

ENTRY PS17-0041
Design And Development of FRP Composite Wicket Gates For Inland Navigation

This poster highlights on the successful installation of the first fiber reinforced polymer (FRP) composite wicket gates in the US navigational infrastructure. These navigational lock gates need to be light-weight, corrosion-resistant, maintenance-free, and durable with high endurance under fatigue loads. These requirements were very difficult to achieve by using conventional materials. But, with the emergence of fiber reinforced polymer (FRP) composites, it has now been possible to accomplish above-mentioned requirements that too at a competitive cost. This poster covers the design, manufacturing, experimental test results, cost analysis, and field implementation of a novel FRP wicket gate in the Mississippi River.

West Virginia University, Piyush Soti, PV Vijay

ENTRY PS17-0046
Prestressed Fiber Reinforced Polymer Composites

A simple method is used to manufacture a prestressed composite part by glass fiber and epoxy resin. Investigation into the development of the mechanical properties due to fiber prestressing.

University of Alabama at Birmingham, Mahmoud Mohamed

ENTRY PS17-0049
Determination of Material Properties For Progressive Damage Analysis Using Abaqus

An energy release rate of thermoplastic composite in Mode I and Mode II is studied for FEM (Finite element Method). The microcracking in laminate composite, which is the first type of damage to appear, is analyzed. Experimental data from laminate specimens were collected from literature to adjust such energy properties. A brief description of initiation and propagation of cracks is introduced. The methodology used through an optimization adjustment is described . The predicted results using PDA with experimental data are compared for some laminate material system. Finally, the effectiveness and limitation of this model, already implemented in Abaqus, is discussed.

West Virginia University, Javier Cabrera Barbero, Ever Barbero

ENTRY PS17-0050
A Study on The Nonlinear Material Model For Improving Accuracy of Hyper-Elastic Material Analysis

The hyper-elastic materials are used in various fields. In marine and offshore engineering field, it is mainly used as an absorber to reduce noise and vibration of equipment on a structure or to prevent impact that could damage the offshore structure and ship. Furthermore, application range of hyper-elastic material has been expanded due to technology development. In this study, in order to improve the accuracy of Hyper-Elastic material analysis, material property tests were performed on four specimens with different stiffness bands. Numerical analysis was performed for 5 representative nonlinear material models for a comparative study with the experimental results.

Korea Research Institute of Ships & Ocean Engineering, Byoungjae Park, Kangsu Lee, Doyoub Kim, Hyun-Seok Kim, Minsuk Ki

ENTRY PS17-0052
Functional And Structural Polymer/Nano-Particle Composites

The results of the research being conducted in the area of developing structural and functional materials by incorporating nano particles in polymeric materials will be presented. The areas of research covered will be electrically and thermally conductive fibers, high impact strength polymer nanocomposites, high strength high modulus carbon fibers, low density high modulus carbon fibers.

Georgia Institute of Technology, Prabhakar Gulgunje, Satish Kumar

ENTRY PS17-0054
On the Successful Fabrication of Auxetic Polyurethane Foams: Morphology and Mechanical Properties

Auxetic foams were successfully fabricated by a convenient and economical process with capabilities in large-scale manufacturing. Auxetic materials have a negative Poisson's ratio, that is, they expand laterally when stretched longitudinally. Negative Poisson's ratio is an unusual property that enhances many of the mechanical properties of the material, such as indentation resistance, compression, shear stiffness. The unusual mechanical properties endow auxetic foams with superior qualities when used in protection equipment, such as helmets, protective vests, and running shoe applications.

Florida State University/ High-Performance Materials Institute, Zhe Liu, Xiaolin Wang, Yan Li, Changchun Zeng

ENTRY PS17-0055
Optimal Design of a Carbon Fiber Toroidal Vessel for Storing Gas for Cars

The design of a toroidal pressure vessel of carbon fiber for storing GLP type gas for automotive is described; The process is performed by virtual testing and through an optimization algorithm called PSO is interacted with an APDL of Ansys so that by means of FEM, a resistant vessel is obtained conditioned by a criterion of failure.

West Virginia University, Darwin Patino, Ever Barbero
Universidad de Cadiz, Spain, Alfonso Corz

ENTRY PS17-0056
Spinning Behaviour And Mechanical Properties Of Polyamide 6/Ferrite-Compounds

Ferrite-enhanced Polyamide 6 compounds have been tested to improve the manufacturing of organic sheets. Ferromagnetic particles are used to give polymers magnetic properties throughout their cross-section. Ferromagnetic particles retain their magnetism once an external field has been shut off. Once the fibres are fully magnetized, effects such as induction can be used until the Curie temperature is surpassed. This allows for the melting to occur through a combination of conductive heating as well as inductive heating in the ferrite-enhanced fibres. By enabling heat transfer within the components, time and energy is saved, reducing the production costs for thermoplastic composites.

ITA of RWTH Aachen University, Robert Brüll, Thomas Gries

ENTRY PS17-0057
Bionic 3D-Braided Composite

The 3D rotation braiding technology is suitable for single-stage production of mechanically and geometrically exacting components. A 3D rotary braiding machine with 144 horn gears is used for production and research of composites parts at ITA. With this technology it is even possible to create highly complex bionic structures, such as the skeleton of the deep-sea sponge Euplectella Aspergillum. It is an excellent model for a highly optimized fibre-based lightweight structure with excellent performance in stiffness and strength.

ITA of RWTH Aachen University, Martin Kolloch

ENTRY PS17-0058
Simulation of the Over Braiding Process for a Pressure Vessel

With the radial braiding technology it is possible to manufacture net-shape textile preforms, for the automotive and aviation industry. Manufacturing simulation allows faster prototyping, by avoiding time-consuming and expensive experiments. FEM simulations of the braiding process with a high accuracy have a simulation time of several days. An alternative are geometric and kinematic simulation models but they have a much lower accuracy because of the limited reproduction of friction. Ideal would be a time efficient FEM-Simulation with the simulation time of minutes.

ITA of RWTH Aachen University, Martin Kolloch

ENTRY PS17-0059
Manufacturing of a Metal Matrix Connecting Rod

Metal matrix composites (MMC) have a great potential for lightweight structural applications. Metal matrix composites withstand elevated temperatures compared to fiber reinforced plastics. Short fibre reinforced composites currently exist. Only a few long fiber reinforcement composites are produced. The full potential of textile reinforced metal matrix composites has not been reached yet. Partial reinforcement saves weight and tools cost.

ITA of RWTH Aachen University, Martin Kolloch

ENTRY PS17-0060
Advanced Composite Rotor Blade using 3D Braiding Technology

The current manufacturing method for composite helicopter blades is extremely labour intensive which in turn washes out the cost savings obtained from light weighting of the blade. Secondly, damage detection is carried out mainly through non-destructive or visual detection techniques leading to significant increase in life cycle costs. An innovative multifunctional composite based solution for a dual step manufacturing process of helicopter blades using 3D Braiding Technology and Out of Autoclave Infusion Technique is used. This proposal offers solutions production cost reduction by atleast 18% and lifecycle cost by atleast 25% while offering advanced solutions for integrated structural health monitoring.

ITA of RWTH Aachen University, Amool Raina, Thomas Gries

ENTRY PS17-0062
Automated Production of Repair Patches for Fiber Composites

This project aims to develop an automated process for the production of custom patches for the aerospace, wind and automotive sector. The goal is to automate the entire process of production of high quality, high tolerance repair patches used for repairing composite structures in the automotive, aerospace and wind energy sectors. A combination of laser cutting technology along with proprietary solutions for handling and application of adhesives will be used for the production of the patch. Further, the use of carbon nanoparticles will be used to increase the residual capacity of the repaired patch.

ITA of RWTH Aachen University, Amool Raina, Marius Wiche, Thomas Gries

ENTRY PS17-0063
Hybrid Yarn Development for Thermoplastic Composites in Visible Automotive Applications

Thermoplastic matrix systems get more important due to their suitability for mass production. A challenge is the high viscosity of the thermoplastic matrix. An approach to reduce the flow paths of the melt is given by a commingling process. An innovative heating system can be realized by infrared heating combined with inductive heating. In this research hybrid yarns containing nanomodified nylon 6 filaments and glass fibres are developed. The industrial research partner develops an innovative vario thermal heating tool. This poster presentation shows the development of such hybrid yarns.

ITA of RWTH Aachen University, Klaus Vonberg, Robert Brüll, Benjamin Mohr, Thomas Gries

ENTRY PS17-0064

Investigations on the Production of Ultra Low-Weight Hollow Carbon Fibres

The main goal of this research work is the development of ultra-low weight hollow carbon fibres. These fibres can be produced quicker than standard carbon fibres and have a reduced weight with comparable mechanical properties. These effects result in a minimized CFRP weight and increase the total cost efficiency. This research shows the production process of hollow carbon fibres. The focus lies on the stabilization and carbonization process. For the stabilization and carbonization process parameters are developed, by which the hollow structure of the fibres is maintained.

ITA of RWTH Aachen University, Robert Brüll, Franz Pursche, Janis Langgartner, Thomas Gries

ENTRY PS17-0066

Composites Recycling Technician Education Program (CRTEP): Building the New Composites Workforce

Composite recycling is crucial and our industry needs to lead its efforts. This creates an impending need for education of current/upcoming composite technicians to properly identify, handle, sort, and catalogue composite fiberglass and carbon fiber waste stream material in manufacturing settings. CRTEP's end goal is to develop a database that houses and tracks various composite waste stream materials across the industry that will also incorporate modules to serve as a database-learning tool. This tool can be retrofit to an existing program providing a certificate pathway, used as continuing education for current technicians, or used by industry for training programs.

University of Alabama at Birmingham, Kristin Hardin, Brian Pillay
Center of Excellence for Marine Manufacturing & Technology, Ann Avary

PARTICIPATING UNIVERSITIES AND ORGANIZATIONS

Center of Excellence for Marine Manufacturing & Technology

Colorado State University

FAMU-FSU College of Engineering

FHNW, Institute of Polymer Engineering

Florida A&M University

Florida State University

Georgia Institute of Technology

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ITA of RWTH Aachen University

Korea Research Institute of Ships & Ocean Engineering

North Carolina A&T State University

North Dakota State University

TUHH, Institute of Polymer and Composites

Tuskegee University

Universidad de Cadiz, Spain

University of Alabama at Birmingham

University of Central Florida

University of Connecticut

University of Miami

University of the Witwatersrand

West Virginia University