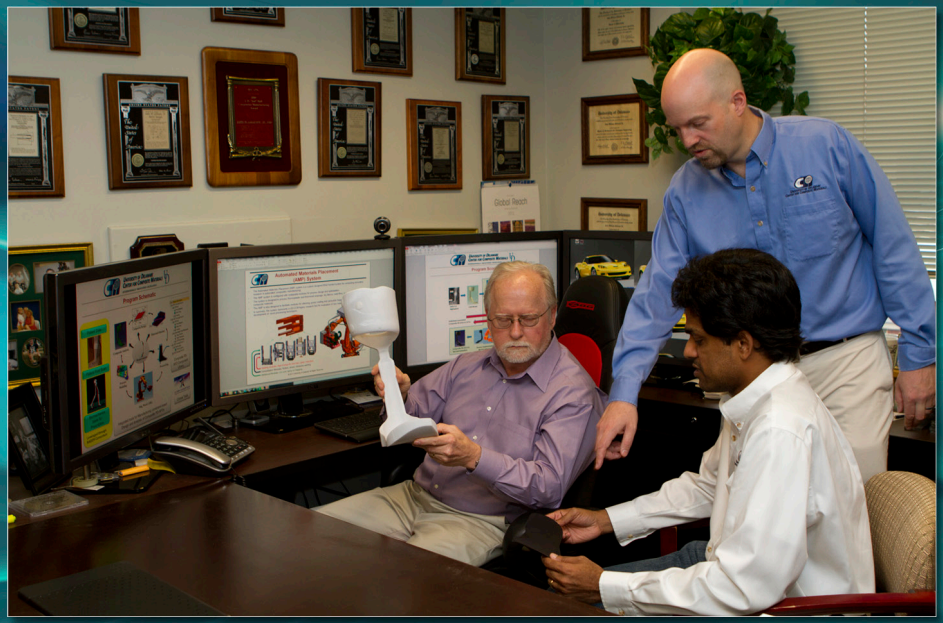


CCM's Jack Gillespie, John Tierney and Shridhar Yarlagadda discuss a prototype for an advanced passive dynamic ankle-foot orthotic.

UDaily

## Research focuses on manufacturing composite orthotics for injured soldiers

10:14 a.m., May 4, 2012--Imagine being able to use a 3-D "printer" to produce a custom orthotic device for a soldier with a severe lower extremity injury. Constructed of strong and durable yet lightweight composite materials, the device is designed to meet the user's specific needs. It can be fabricated in just 24 hours, and its "tunable" properties allow it to be modified to meet the wounded warrior's changing needs over the course of rehabilitation.

University of Delaware
Center for Composite Materials

COMPOSITES UPDATE
May 2012

This description may sound like the stuff of futuristic medical fiction, but it's actually the objective of a new research program at the University of Delaware Center for Composite Materials (CCM).

Led by Jack Gillespie and Shridhar Yarlagadda, CCM recently received a grant from the Defense Advanced Research Projects Agency (DARPA) to develop a rapid prototyping process for the manufacture of advanced passive dynamic ankle-foot orthoses (PD-AFOs) for injured soldiers. The three-year, $3-million project will be carried out in collaboration with UD's BADER Consortium, which will enable the new devices to be tested in clinical trials.

Steven Stanhope, who leads the BADER Consortium and is a co-investigator on the new DARPA project, explains that PD-AFOs, which use a spring-like action to mimic the normal motion of the ankle, are enabling wounded warriors to retrain not only for a vigorous recreational lifestyle but also for active duty.

With a process known as additive manufacturing, in which 3-D solid objects are built up in layers from digital files, Stanhope has invented a patent pending process for the rapid manufacture of PD-AFOs from "neat," or unreinforced polymers.

## TOP STORY (Continued)

However, these materials are limited in strength and durability, and the devices must be thick and heavy to meet the soldier's need for active duty.

In contrast, high-performance composites can reduce device size and offer improved mobility.

"If we can take full advantage of composites — which are 40 times stiffer and stronger than conventional materials — we can pare these devices down to the point where they will be thin enough to be readily worn within a shoe," Gillespie says. "We can also use the anisotropic properties of composites to 'stiffness tune' a device to an individual patient's impairment profile, enabling an unprecedented level of customization, not just initially but on a continuing basis."

However, customized composite devices require labor-intensive and specialized skills to fabricate, so the DARPA-funded research is aimed at marrying the rapid production enabled by additive manufacturing with the performance advantages of composites.

That sounds like a tall order, but the new program builds on CCM's well-developed composites manufacturing science base.

"Our goal is to develop integrated tools for manufacturing to meet the system requirements," says Yarlagadda, who directs other DARPA-funded composites manufacturing research at CCM. He explains that those tools include process models, composites analysis, composites design, materials selection, process engineering, and manufacturing workcells in a continuous feedback loop centered on the requirements of the application.

In the new project, those tools will be complemented by patient data, patient foot scans, and biomechanics-based prescriptions for devices provided through the BADER Consortium.

**Click here to read the full story in UDaily**

*Photo courtesy of the NEWS JOURNAL*

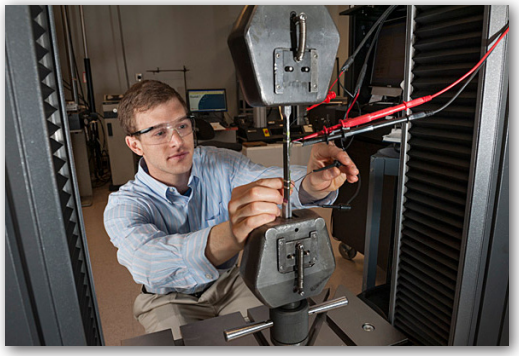

*The University of Delaware's John Tierney (left) and John Gillespie use 3D computer imaging to create custom orthotics. The project, originally to help soldiers, also will benefit civilians. / THE NEWS JOURNAL/ GARY EMEIGH*

**Click here to read the NEWS JOURNAL article**

BADER CONSORTIUM
Bridging Advanced Developments for Exceptional Rehabilitation

# OTHER NEWS

*Photo compliments of UDaily*



*Zachary Melrose, a UD doctoral student in mechanical engineering, has been awarded a prestigious National Defense Science and Engineering Graduate Fellowship.*

UDaily

## Grad student wins defense fellowship to develop multifunctional composites

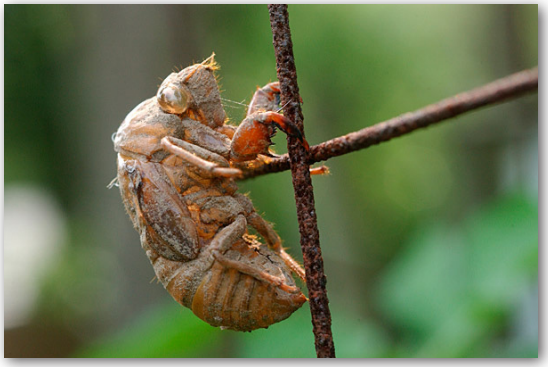
10:08 a.m., May 14, 2012--Nanomaterials may be small, but they offer a tremendous range of properties and possible applications. Carbon nanotubes can provide the foundation for multifunctional structures that sense and heal damage within themselves while also serving other roles such as energy storage, thermal management, and electromagnetic interference shielding.

Zachary Melrose, a doctoral student in mechanical engineering at the University of Delaware, plans to exploit that potential in his doctoral research at UD's Center for Composite Materials. Melrose, from Voorhees, N.J., has been awarded a prestigious National Defense Science and Engineering Graduate (NDSEG) Fellowship to support his development of multifunctional structural composites through the selective integration of nanomaterials in composites. He is advised by Erik Thostenson, assistant professor.

**Click here to read the full story in UDaily.**

## For treatment of vocal fold disorders, UD researchers look to insect protein

*Photo compliments of UDaily*



*UD researchers are developing new materials, modeled after the protein resilin found in insects such as the cicada, which may be useful in treating vocal fold disorders.*

9:03 a.m., April 24, 2012--A one-inch long grasshopper can leap a distance of about 20 inches. Cicadas can produce sound at about the same frequency as radio waves. Fleas measuring only millimeters can jump an astonishing 100 times their height in microseconds. How do they do it? They make use of a naturally occurring protein called resilin.

Resilin is a protein in the composite structures found in the leg and wing joints, and sound producing organs of insects. Highly elastic, it responds to exceptionally high rates of speed and demonstrates unmatched resilience after being stretched or deformed.

Kristi Kiick, professor of materials science and engineering and biomedical engineering at the University of Delaware, believes this unusual protein may also be a key to unlocking the regenerative power of certain mechanically active tissues.

**Click here to read the full story in UDaily**

# OTHER NEWS

## Wool to Serve on International Advisory Committee

CCM affiliated faculty member Richard Wool, professor of chemical engineering, has been named to the International Advisory Committee of ACUN-6: Composites & Nanocomposites in Civil, Offshore and Mining Infrastructure, which will be held from Nov. 14–16, 2012, at Monash University in Melbourne, Australia.

ACUN (Australia, Canada, U.S., New Zealand) will bring together the latest research and developments on a full range of composite materials and their structural applications.

Sri Bandyopadhyay, associate professor in the School of Materials Science and Engineering at the University of New South Wales in Australia, is conference chair. Bandyopadhyay spent a year (1997-98) as a visiting professor at CCM with Wool.

For more information, visit the website: **http://www.acun6.org.**

# NEW PUBLICATIONS

## Journals

Erkendirci, Ö. F., and (Gama) Haque, B. Z. "Investigation of Penetration Mechanics of PW Kevlar Fiber Reinforced HDPE Composites," International Journal of Damage Mechanics, doi: 10.1177/1056789512445401, 2012. Click here for hyperlink.

Erkendirci, Ö. F., and (Gama) Haque, B. Z. "Quasi-Static Penetration Resistance Behavior of Glass Fiber Reinforced Thermoplastic Composites," Composites: Part B., doi:10.1016/j.compositesb.2012.01.053, 2012. Click here for hyperlink.

(Gama) Haque, B. Z., M. M. Kearney, and J. W. Gillespie, Jr., "Advances in Protective Personnel and Vehicle Armors," Recent Patents and Materials Science, 5 (2), pp. 103-134, 2012. Click here for hyperlink.

Sargianis, J, H I. Kim, and J. Suhr, "Natural Cork Agglomerate Employed as an Environmentally Friendly Solution for Quiet Sandwich Composites." Scientific Reports, 2:403, doi:10.1038/srep00403, 2012. Click here for hyperlink.

Wu, A. S., T-W. Chou, J. W. Gillespie, Jr., D. Lashmore, and J. Rioux, "Electromechanical Response and Failure Behaviour of Aerogel-spun Carbon Nanotube Fibres under Tensile Loading," Journal of Materials Chemistry, doi: 10.1039/c2jm15869h, 22 (14) pp. 6792-7698, 2012. Click here for hyperlink.

## Conferences

Chowdhury, S. C. , B. A. (Gama) Haque, J. W. Gillespie, Jr., and D. R. Hartman, "Molecular Dynamics Simulation of Defective Carbon Nanotubes under Combined Loading Conditions," SAMPE 2012, Baltimore, MD, May 21-24, 2012.

# NEW PUBLICATIONS (Continued)

Dempah, M. J., R. Tirschmann, D. Heider, and J. W. Gillespie, Jr., "Permeability Characterization of Materials for Advanced Bagging Concepts," SAMPE 2012, Baltimore, MD, May 21-24, 2012.

Gama, B. A. and J. W. Gillespie, Jr., "Virtual Testing of Composites using Micro-Mechanical to Macro-Mechanical Unit Cell Approach," ASME 2011 IMECE, Denver, CO, November 11-17, 2011.

Gruber, M. B., I. Z. Lockwood, T. L. Dolan, S. B. Funck, J. Tierney, P. Simacek, J. W. Gillespie, Jr., S. G. Advani, B. J. Jensen, and R. J. Cano, "Thermoplastic in Situ Placement Requires Better Impregnated Tapes and Tows," SAMPE 2012, Baltimore, MD, May 21-24, 2012.

Haque (Gama), B. Z., S. C. Chowdhury, I. Biswas, P. M. Schweiger, J. W. Gillespie, Jr., and D. R. Hartman, "Modeling the Low Velocity Impact Damage Behavior of S-Glass/Phenolic Composites,"SAMPE 2012, Baltimore, MD, May 21-24, 2012.

Kelly, G. S., S. G. Advani, J. W. Gillespie, Jr., and T. A. Bogetti, "Thermo-Mechanical Modeling of Acoustic Softening During Ultrasonic Consolidation of Thin Metal Foils," SAMPE 2012, Baltimore, MD, May 21-24, 2012.

Levy, A. , D. Heider, J. Tierney, J. W. Gillespie, Jr., P. Lefebure, and D. Lang, "Simulation and Optimization of the thermoplastic Automated Tape Placement (ATP) Process," SAMPE 2012, Baltimore, MD, May 21-24, 2012.

Levy, A., J. Tierney, D. Heider, J. W. Gillespie, Jr., P. Lefebure, and D. Lang, "Modeling of Inter-Layer Thermal Contact Resistance During Thermoplastic Tape Placement," SAMPE 2012, Baltimore, MD, May 21-24, 2012.

McCauley, R., S. Yarlagadda, P. Pa, M. Mirotznik, and M. Keefe, "Mechanical Behavior of Composite Laminates with Electromagnetic High Impedance Surfaces," SAMPE 2012, Baltimore, MD, May 21-24, 2012.

Mueller, J. E., J. W. Gillespie, Jr., and S. G. Advani, "Interaction Volume Effects of Ultrasonically Consolidated Cu-Al Concentration Profiles," SAMPE 2012, Baltimore, MD, May 21-24, 2012.

Tierney, J. J., J. W. Gillespie, Jr., R. Stratton, M. Glenn, J. Tzeng, and M. Maher, "Design and Optimization of an Exospine Structure Utilizing Lightweight Composites," SAMPE 2012, Baltimore, MD, May 21-24, 2012.

Tierney, J. J., R. Weber, N. Shevchenko, D. Heider, S. Yarlagadda, and J. W. Gillespie, Jr., "Development of an Automated Materials Placement (AMP) System for Composite Processing," SAMPE 2012, Baltimore, MD, May 21-24, 2012.

# NEW PUBLICATIONS (Continued)

Zhang, D., A. Levy, and J. W. Gillespie, Jr., "On the Void Consolidation Mechanisms of Continuous Fiber Reinforced Thermoplastic Composites," SAMPE 2012, Baltimore, MD, May 21-24, 2012.

## On-Line

Lopatnikov, S., N. Shevchenko, and J. W. Gillespie, Jr., "Device and Method for Investigation of Mechanical Properties of Fibers under High-Strain Rate Tensile Load," (http://arxiv./abs/1201.0916), January, 2012.

Kang, S-G., B. A. Gama, S. Yarlagadda, and J. W. Gillespie Jr., "Finite Element Modeling of Delamination in Thick-Section Composites Using LS-Dyna," The 24th Annual Technical Conference presented by the American Society for Composites and the Canadian Association for Composite Structures and Materials, University of Delaware, Sept. 15-17, 2009.

Keenan, C. D., J. W. Gillespie, Jr., D. Heider, R. Jensen, T. Bogetti, R. Adkinson, and J. D. Bender, "Process Capabilities for the Infusion of High Viscosity Polyurea Resin Systems for Composite Applications," The 24th Annual Technical Conference presented by the American Society for Composites and the Canadian Association for Composite Structures and Materials, University of Delaware, Sept. 15-17, 2009.

McAllister, Q. P., J. W. Gillespie, Jr., and J. R. VanLandingham, "Nanoindentation of High Performance Fibers," The 24th Annual Technical Conference presented by the American Society for Composites and the Canadian Association for Composite Structures and Materials, University of Delaware, Sept. 15-17, 2009.

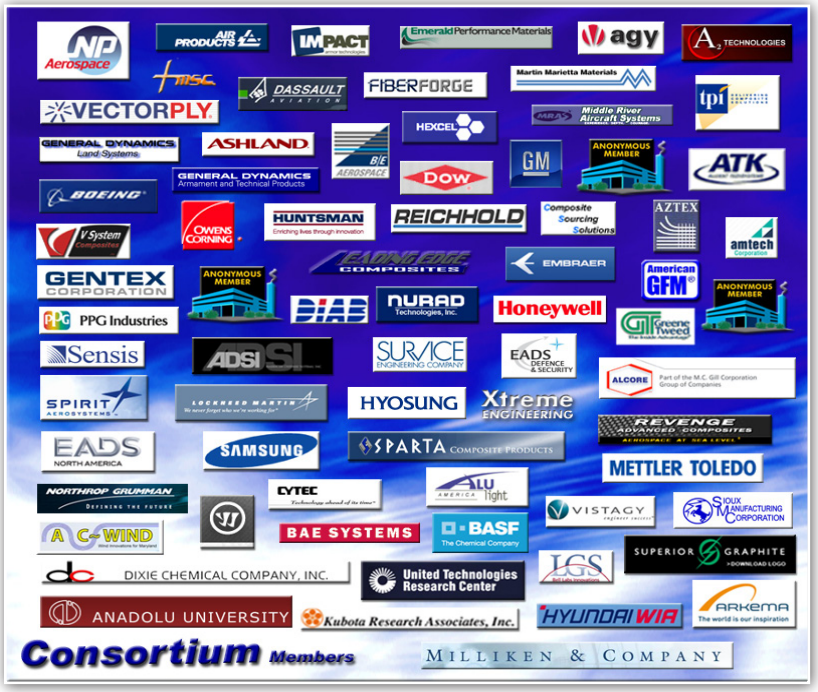
Qiu, L., M. E. Teitelbaum, K. W. Goossen, D. Heider, D. J. O'Brien, and E. D. Wetzel, "Free Space Optical Coupling to Embedded Fiber Bragg Grating Sensors Through Panel Surfaces", The 24th Annual Technical Conference presented by the American Society for Composites and the Canadian Association for Composite Structures and Materials, University of Delaware, Sept. 15-17, 2009.

Kissounko, D. A., K. M. Danner, J. M. Deitzel, J. W. Gillespie Jr. "Synthesis and Characterization of Electrospun Conductive Metal and Complex Metal Oxide Nanofibers," American Society of Mechanical Engineers 2009 International Congress, IMECE2009-12385, Orlando, FL, November 16-21, 2009.

## CONSORTIUM MEMBER NEWS

We would like to thank **Anadolu University, Turkey**, for becoming our newest consortium member and **Kubota Research Associates, Inc**., Hockessin, DE, and **3M Corporate Research**, Maplewood, MN for the recent renewal of their membership. We would also like to thank our many other members for continuing to participate in CCM's research and development activities.

To learn more about the benefits of becoming a member, please visit us on the web at **www.ccm.udel.edu/Consortium/benefits.html**




*Celebrating 38 years of significant contributions to composites science and technology, the education of students, and the creation and transfer of technology to industry.*

38th Anniversary

CELEBRATING 38 YEARS OF SIGNIFICANT CONTRIBUTIONS TO SCIENCE AND TECHNOLOGY, THE EDUCATION OF STUDENTS, AND THE CREATION AND TRANSFER OF TECHNOLOGY TO INDUSTRY

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