University of Delaware
Center for Composite Materials

COMPOSITES UPDATE
June 2012

Photo by Evan Krape

From left, Hyung-ick Kim, James Sargianis and Jonghwan Suhr

Top Story

Paper Details Use of Natural Material Cork for Quiet Sandwich Composites

Cork, known for its use in such low-tech applications as wine bottle stoppers and bulletin boards, now shows promise as the core material in composite sandwich structures for use in high-tech automotive, aircraft and energy applications.

A research team at the University of Delaware is investigating this natural material as an environmentally friendly solution for quiet sandwich composites. They recently published a paper on the work in Scientific Reports, an online, open-access research publication from the publishers of Nature that covers all areas of the natural sciences.

"Cork is a natural product with intriguing properties," says Jonghwan Suhr, assistant professor in the Department of Mechanical Engineering and an affiliated faculty member in the Center for Composite Materials.

"It's energy absorbing, tough, lightweight and impact resistant, and it has excellent vibrational and acoustic damping properties. Its unique cellular arrangement also results in good thermal properties, and it's impermeable to moisture."

Suhr was adviser to the lead author on the paper, James Sargianis, who completed his master's degree in mechanical engineering at UD in May. The third member of the team was Hyung-ick Kim, a postdoctoral researcher at CCM who is an expert in mechanical characterization of advanced materials.

TOP STORY (Continued)

Sargianis's graduate research focused on exploring natural material-based sandwich composites with enhanced noise mitigation. Cork turned out to be one of the most promising alternatives to traditional sandwich structures.

Suhr explains that composite sandwich structures — typically made from synthetic foam cores or honeycomb materials bonded to carbon-epoxy face sheets — are commonly used in aerospace applications because they offer high bending stiffness and are very lightweight. However, he says, they are also good at radiating noise, which is not a desirable feature in an airplane. The current solution is to line the interior with four to six inches of glass fabric, but this increases weight and reduces space inside the cabin.

Enter cork as the new core for the sandwich.

In the recently reported study, the researchers compared sandwich structures made from a natural cork agglomerate core with those using a core made from a high-quality synthetic foam called Rohacell. Carbon-epoxy was used as the face sheet material with both cores.

"We achieved a 250 percent improvement in damping performance using the cork-based materials, with no sacrifice in mechanical properties," Suhr says. "Further, cork radiates little to no noise and is inexpensive. It's also sustainable and environmentally friendly because there are no carbon emissions associated with its production."

Since the paper was published in May, the team has been approached by Portugal-based Amorim, a world leader in the production of thermal and acoustic insulation materials based on natural raw cork.

In an email to Suhr, a company representative referred to the article as "excellent" and wrote, "We are astonished and very well surprised with such detail on your study." A group from Amorim plans to visit UD soon to learn more about the work.

Suhr sees the potential for application of cork-based sandwich structures in not only aircraft cabins but also car engine mounts, launch vehicle fairings, and wind turbine blades.

In the next phase of the project, the team will investigate the low-velocity impact of these materials.

Sargianis, who also earned his bachelor's degree at UD, in 2010, has accepted a position with the Naval Air Systems Command (NAVAIR) in Lakehurst, N.J. He took first-place honors at the 2012 SAMPE National Student Research Symposium in May for his work on natural material based-sandwich composites.

"It was great to work with James while he was here at UD," Suhr says. "He knows what he's doing, and he's a great problem solver. I have no doubt that he will become a leader in science and technology."

Article by Diane Kukich

OTHER NEWS (Continued)

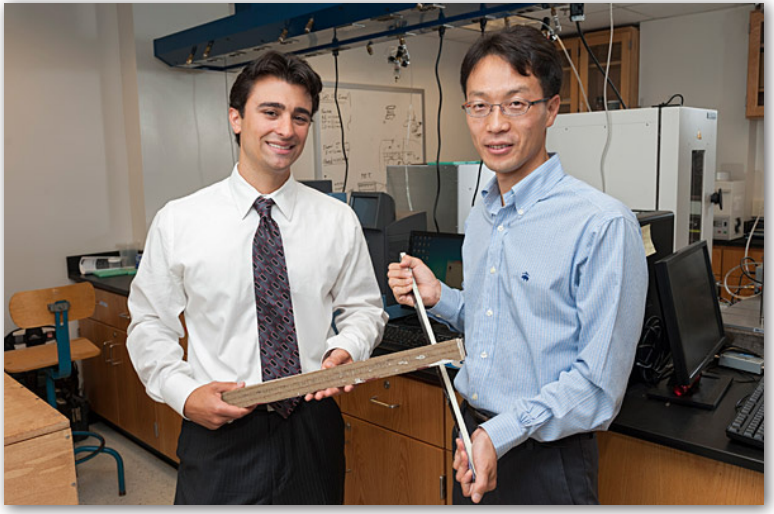
CCM-affiliated student wins national materials award

James Sargianis, who recently completed his master's degree at the University of Delaware, took first-place honors at the 2012 SAMPE National Student Research Symposium in May. His paper, "Natural Material Based Sandwich Composites with Enhanced Noise Mitigation," was selected from a pool of six finalists across the U.S. in the master's degree category.

Sargianis is affiliated with the UD Center for Composite Materials (CCM) and advised by Jonghwan Suhr, assistant professor in the Department of Mechanical Engineering.

"Sandwich composite structures offer superior mechanical properties at a low weight and are therefore quite popular in applications such as aircraft cabins and wind turbine blades," Sargianis says. "However, sandwich structures made with traditional materials aren't good at reducing noise and vibration, so we're looking to natural materials to see if we can improve those properties."

"The advantage to using natural materials, as opposed to synthetic materials such as carbon or glass fibers," he adds, "is that we can essentially 'grow' our own materials and reduce the carbon emissions associated with synthetic material production. In addition, natural materials are recyclable and biodegradable."



James Sargianis (left) with his adviser, Jonghwan Suhr

Sarginias is co-author, with Suhr and CCM postdoctoral researcher Hyung-ick Kim, of a paper recently published in Scientific Reports detailing the use of cork as an environmentally friendly solution for quiet sandwich composites. Scientific Reports is a new initiative of the prestigious journal Nature.

"James is an absolutely outstanding student," says Suhr. "He just finished his master's degree, and he has already published two papers in reputable, refereed journals and has two more under review. He is a self-motivated, hard-working problem solver who requires minimal direction. I have no doubt that he will become a leader in science and technology."

OTHER NEWS (Continued)

CCM Director Jack Gillespie, who serves as faculty adviser to the UD student SAMPE chapter, notes that Sargianis is the latest in a long line of composites students who have taken top prizes at SAMPE competitions.

"We've been fortunate to attract top students to the center, and in turn the environment here helps them reach their potential as researchers and leaders," Gillespie says.

Sargianis, who earned his bachelor's degree at UD in 2010, has accepted a position with the Naval Air Systems Command (NAVAIR) in Lakehurst, N.J.

Article by Diane Kukich

UD-CCM Celebrates 2012 Student Achievement Day

UD-CCM held its annual Student Achievement Day Awards Ceremony on May 11, 2012 from 1-4 p.m. in the Composites Manufacturing Science Laboratory, celebrating the academic successes of CCM's highest achieving students.

Education is CCM's most important product and we believe in the importance of recognizing the achievements of our students. The knowledge gained in our center furthers the scientific inquiry and technological advances in composites all over the world.

Please click here to view 2012 Student Achievement Day event photos.
View in Slideshow Mode (upper left corner) for enlarged images.

About SAMPE

The Society for the Advancement of Material and Process Engineering (SAMPE), an international professional member society, provides information on new materials and processing technology via technical forums, journal publications, and books. As the only technical society encompassing all fields of endeavor in materials and processes, SAMPE provides a unique and valuable forum for scientists, engineers, and academicians.

OTHER NEWS (Continued)

Congratulations to Our 2012 Student Achievement Day Award Winners

R. L. McCullough Scholars Award
Recipient: Quinn McAllister, PhDMSEG
Advisors: Professor John W. Gillespie, Jr. and Dr. Mark Vanlandingham

Progress Award
Recipient: Qi An, PhDMSEG
Advisor: Professor Erik T. Thostenson
Recipient: John Gangloff, PhDME
Advisor: Professor Suresh G. Advani

Achievement Award
Recipient: James Sargianis, MME
Advisor: Professor Jonghwan Suhr

Outstanding Senior Award
Recipient: Devin Prate, BME
Advisor: Professor Jonghwan Suhr
Recipient: EricWurtzel, BME
Advisor: Professor Suresh G. Advani

Undergraduate Research Award
Recipient: Christine Gregg, BME
Advisor: Professor Erik T. Thostenson
Recipient: Jessica Harrington, BME
Advisor: Dr. Bazle Z. Haque
Recipient: Peter Lessik, BME
Advisor: Dr. Shridhar Yarlagadda
Recipient: Matthew Sinnott, BME
Advisor: Professor Erik T. Thostenson

CCM Scholarship Award
Recipient: Dr. Bazle Haque
Advisor: Professor John W. Gillespie, Jr.

NEW PUBLICATIONS

Journals

An, Q., A. N. Rider and E. T. Thostenson, "**Electrophoretic Deposition of Carbon Nanotubes onto Carbon-Fiber Fabric for Production of Carbon/Epoxy Composites with Improved Mechanical Properties**," Carbon, 50 (11), pp. 4130-4143, 2012.

Cromer, K., J. W. Gillespie, Jr. and M. Keefe, "**Effect of Multiple Non-coincident Impacts on Residual Properties of Glass/Epoxy Laminates**," Journal of Reinforced Plastics and Composites, 2012 31: 815, doi: 10.1177/0731684412448221.

Gillespie, Jr., J. W., L. A. Carlsson, A. A. Gawandi, and T. A. Bogetti, "**Fatigue Crack Growth at the Face Sheet-Core Interface in a Discontinuous Ceramic-Tile Cored Sandwich Structure**", Composite Structures, http://dx.doi.org/10.1016/j.compstruct.2012.05.021.

Jang, J-S., J. Varischetti, and J. Suhr, "**Strain Dependent Energy Dissipation in Multi-Scale Carbon Fiber Composites Containing Carbon Nanofibers**," Carbon, 50, pp. 4277-4283, 2012.

Pandey, G, M. Wolters, E. T. Thostenson, and Dirk Heider, "**Localized Functionally Modified Glass Fibers with Carbon Nanotube Networks for Crack Sensing in Composites using Time Domain Reflectometry**," Carbon, 50 (10), pp. 3816-3825, 2012.

Conferences

Gangloff, Jr., J. J., R. Readdy, and S. G. Advani, "The Effects of Targeted Applied Vibrations to Promote Void Reduction During Composites Processing", SAMPE Conference & Exposition, Baltimore, MD. May 21-24, 2012.

Jang, J-S, R. F. Gibson, and J. Suhr, "Characterization of Particle Diameter and Interphase Effects on Young's Modulus of SiO2/ Epoxy Particulate Composites, Proceedings of the SPIE Structures/NDE 2012 – Behavior and Mechanics of Multifunctional Materials and Composites, San Diego, CA, March 11-15, 2012.

NEW PUBLICATIONS (Continued)

Jang, J-S., H. Kim, W. Zhao, and J. Suhr, "Investigation of Particle Size Effect on Fracture Toughness of SiO2/Epoxy Particulate Composites, SAMPE 2012, Baltimore, MD, May 21-24, 2012

Lasater, K., E. T. Thostenson, and W. R. Yu, "In Situ Monitoring of Cure and Viscoelastic Behavior of Composites Using Carbon Nanotubes," SAMPE 2012, Baltimore, MD, May 21-24, 2012.

Shrank, E. S., A. R. Razzook, K. Takahashi, J. Tierney, J. W. Gillespie, Jr., K. Wallace, R. Moore, L. Hitch, J. S. Higginson, and S. J. Stanhope, "A Repeatable and Predictable Method to Rapidly Manufacture Function-Customized Passive-Dynamic Ankle Foot Orthoses," Proceedings of the ASME 2012 Summer Bioengineering Conference SBC2012, Farjardo, Puerto Rico, USA, June 20-23, 2012, (Abstract)

COLLEGE NEWS

Thomas H. Epps, III, associate professor in the College of Engineering, has been named the Thomas and Kipp Gutshall Chair of Chemical and Biomolecular Engineering.

Click here to read this entire story in UDaily..

CONSORTIUM MEMBER NEWS

We would like to thank **Starfire Systems, Inc., Schenectady, NY**, for becoming the newest members of our Consortium. We would also like to thank **BAE Systems, Phoenix AZ** , for the recent renewal of their consortium membership.

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

1974-2012

Please visit us on the web at **http://www.ccm.udel.edu**

201 Composites Manufacturing Science Laboratory • phone 302.831.8149
University of Delaware, Newark, Delaware 19716-3144 • fax 302.831.8525