University of Delaware
Center for Composite Materials

COMPOSITES UPDATE
January 2013

Photo courtesy of UDaily

Top Story
NSF Career Award: Thostenson receives prestigious National Science Foundation award

Erik Thostenson's fascination with composite materials grew out of his love for downhill skiing. "I was intrigued that the performance characteristics of various skis could be remarkably different, yet the skis themselves could look identical," he says. "The same basic materials — graphite, carbon, and Kevlar — are used in most high-tech skis, but advanced composite technology enables mogul skis to be flexible while racing skis are stiff."

UD's Erik Thostenson has received a National Science Foundation Career Award to investigate a new processing approach for novel multi-scale hybrid composites with functionally graded material properties.

Two decades later, Thostenson is still fascinated with these high-tech materials and their almost limitless potential to be tailored for applications far beyond high-performance skis.

Now an assistant professor in UD's Department of Mechanical Engineering with a secondary appointment in the Department of Materials Science and Engineering, he recently received a prestigious five-year, $400,000 Faculty Early Career Development Award from the National Science Foundation (NSF) to investigate a new processing approach for novel multi-scale hybrid composites with functionally graded material properties.

The research exploits the unique properties of carbon nanotubes, whose size offers opportunities while also presenting challenges.

"Because nanotubes are so small, they can penetrate the polymer-rich area between the fibers of individual yarn bundles as well as the spaces between the plies of a fiber composite," says Thostenson, who is also an affiliated faculty member in UD's Center for Composite Materials (CCM).

TOP STORY *Continued*

"The nanotubes become completely integrated into advanced fiber composite systems, adding functionality without altering the microstructure of the composite."

The problem? How to get the nanotubes where they need to be so they can do their job.

Thostenson plans to study an environmentally friendly water-based processing technique as an alternative to current energy-intensive approaches for integrating carbon nanotubes within fibrous structures.

"Our preliminary research has established an efficient technique for producing very stable aqueous suspensions of highly dispersed carbon nanotubes in a single processing step," he says. "The technique enables the nanotubes to fully penetrate fiber bundles and form chemical bonds with the fiber surface."

Major advantages of the proposed approach are that it is carried out under ambient conditions and is industrially scalable for future applications.

"This is important for the future use of these hybrid materials, which offer remarkable improvements in shear strength, fracture toughness, and electrical conductivity over traditional fiber-reinforced composites," Thostenson says. "Our work is paving the way for integrating adaptive, sensory, and energy storage capabilities into structural composite materials."

With an undergraduate degree in composite materials engineering from Winona State University in Minnesota, Thostenson first came to UD in 1995 to study at CCM as a center-affiliated graduate student.

"CCM is unique in terms of both facilities and personnel," he says. "The environment is highly interdisciplinary and greatly facilitated my growth as an independent researcher. I knew that my future students would benefit from the same environment."

Click here to read the entire story in UDaily.

About the the NSF Career Award

The Faculty Early Career Development Program offers the National Science Foundation's most prestigious awards in support of junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education, and the integration of education and research within the context of the mission of their organizations.

OTHER NEWS

UDaily Story

Composites leader honored

UD's Gillespie named American Society for Composites Fellow

8:57 a.m., Nov. 1, 2012--John W. Gillespie, Jr., director of the University of Delaware Center for Composite Materials, has been named an American Society for Composites (ASC) Fellow.

ASC Fellows are distinguished members who have made "genuinely outstanding contributions to the composites community through research, practice, education, and/or service."

Gillespie, who is the Donald C. Phillips Professor of Civil and Environmental Engineering with a joint appointment in materials science and engineering, has actively supported ASC since the Society's founding in 1986, including co-authoring 91 conference papers with members of his research group.

From 1990 to 1997, he served as a member of the ASC executive committee. In 2009, he was co-chair of the 24th Technical Conference and the First Joint U.S.-Canadian Conference, which was held at UD.

He received ASC's Outstanding Research Award in 2009 and the society's best paper award at the 25th Technical Conference in 2010.

In achieving ASC Fellow status, Gillespie joins 42 other internationally recognized experts in the composites field from academia, industry and government laboratories.

Click here to read the entire story in UDaily.

Professor Jack Gillespie
Director, Center for Composite Materials
Donald C. Phillips Professor of Civil and Environmental Engineering
Department of Materials Science and Engineering
Department of Civil and Environmental Engineering

About John W. Gillespie, Jr.

Gillespie earned his doctorate in mechanical and aerospace engineering at UD. He joined CCM in 1981 and was named director in 1996.

He is the principal investigator of two Army Research Laboratory (ARL) centers of excellence at UD, one in multifunctional composite materials and the other in mechanics and performance of composites. He is also the UD principal investigator and a member of the consortium management committee of an ARL Collaborative Research Alliance focused on materials in extreme dynamic environments, which was awarded to a team comprising Johns Hopkins University, Rutgers University and California Institute of Technology.

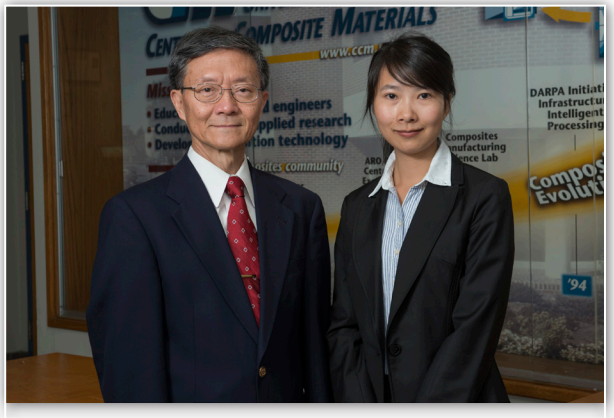
In addition, Gillespie is co-principal investigator of a fourth center of excellence focused on advanced materials and intelligent processing funded by the Office of Naval Research.

OTHER NEWS (Continued)

UDaily Story
Pushing boundaries

Engineers report research milestones in fuel cells, flexible composites

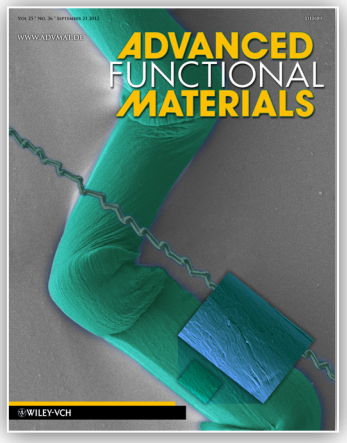
12:34 p.m., Jan. 22, 2013--Faculty and students in the University of Delaware's College of Engineering continue to blaze a trail of innovation, reporting recent research milestones in flexible composites and fuel cells.



Professor Tsu-Wei Chou and Mei Zu, a visiting student from Tongji University

Photo by Kathy F. Adkinson

The Chou research group recently reported success in fabricating flexible composites based on carbon nanotube (CNT) fibers in the high impact factor journal, Advanced Functional Materials (AFM). A micrograph image illustrating the pattern of a buckled CNT fiber in the stretchable conductor was selected as the journal's cover photo for the January 2013 issue.



Cover design by Dawn Marie Fiore, CCM Graphic Designer

Both light and strong, carbon nanotubes (CNTs) are known as a revolutionary material with excellent mechanical, electrical and thermal properties. Continuous CNT fibers are one-dimensional assemblies of CNTs that show potential to retain the superb properties of individual CNTs on a macroscopic scale. They belong to a new class of nano-structured materials with potential applications in electronics, sensing and conducting wires.

Motivated by their high electrical conductivity and ability to kink without cracking, Tsu-Wei Chou, Pierre S. du Pont Chair of Engineering, and his research team used CNT fibers to fabricate a stretchable conductor. The result was a CNT fiber/PDMS flexible composite that can be subjected to repeated stretching-and-releasing cycles up to a prestrain level of 40 percent with little variation in electrical resistance.

According to the paper's lead author Mei Zu, a visiting student from Tongji University in Shanghai, China, these findings demonstrate the potential of these flexible CNT fibers to be used as reinforcements for ultra-light weight multifunctional composites.

Under Chou's guidance, Zu spent two years exploring the electrical and mechanical behavior of CNT-based fibers and composites as a doctoral student in UD's Department of Mechanical Engineering and at the Center for Composite Materials.

This research was supported in part by the U.S. Air Force Office of Scientific Research and the National Research Foundation of Korea through the Global Research Laboratory program.

Click here to read the entire story in UDaily.

OTHER NEWS (Continued)

SAMPE Hosts Boeing Recruitment Event at CCM

A Boeing recruitment event hosted by the University of Delaware Center for Composite Materials drew a standing-room-only crowd on November 15, 2012.

More than 100 students turned out for the presentation, which included an introduction to Boeing, some examples of the company's global products and services, and technologies specific to the Materials, Manufacturing, Structures & Support (MMSS) group—for example, out-of-autoclave composites, materials by design, and paint and coatings.

"We were extremely happy with the turnout," said Anthony Hendrickson, Materials & Process Engineering, Boeing Philadelphia. "This recruiting event again highlighted the unique synergy that CCM provides to join academia with industry. I believe it was an excellent means of highlighting the importance of CCM and its research activities among interested engineering students."

The event was organized by the student SAMPE chapter.

"SAMPE helps students connect with alumni like Anthony," said president Maxime Dempah, a CCM affiliated graduate student in Materials Science & Engineering. "When the company has openings, they'll turn to SAMPE because they know our students have broad experience not only with basic research but also with processing, characterization, and testing."

Hendrickson credits CCM with "excellent organization and promotion of the event at UD."

"We're hoping to host a similar recruiting effort at UD in the spring," he said, "and CCM is our top choice for a venue."

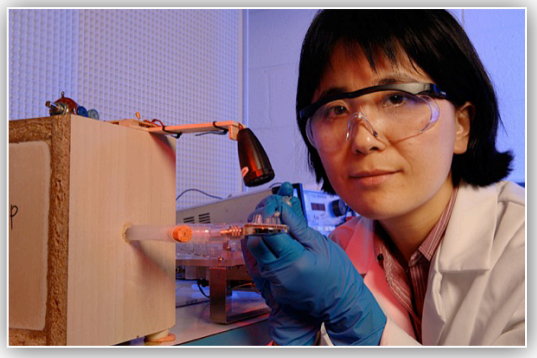
By Diane Kukich

OTHER NEWS (Continued)

UDaily Story

Promising Nanotechnology

Nanotechnology for drug delivery shows promise in treatment of pediatric leukemia



UD-CCM affiliated faculty member Xinqiao Jia and her research team are working with Nemours to develop nanotechnology that could potentially deliver chemotherapy to children in a way that attacks cancer cells without harming healthy cells, greatly reducing side effects.

8:33 a.m., Dec. 4, 2012--Nanotechnology developed by Delaware scientists could potentially deliver chemotherapy to children in a way that attacks cancer cells without harming healthy cells, greatly reducing side effects.

The work, conducted by researchers in the University of Delaware's Department of Materials Science and Engineering and Nemours Center for Childhood Cancer Research, was published this month in the journal Molecular Pharmaceutics.

To date, nanoparticle-based drug delivery approaches have been poorly developed for the treatment of childhood leukemia, which comprises 30 percent of childhood cancers. In the Nemours study, encapsulated dexamethasone ("dex") delivered to pre-clinical mouse models with leukemia significantly improved quality of life and survival compared to the control receiving the unencapsulated drug.

Acute lymphoblastic leukemia (ALL) is the most common form of pediatric leukemia. Although 5-year survival rates for ALL approach 90 percent with available chemotherapy treatments, the harmful side effects of the drugs, including secondary cancers and fertility, cognitive, hearing and developmental problems, present a significant concern for survivors and their families. Dex is one of the most commonly used drugs to treat childhood leukemia and long-term systemic exposure to dex causes considerable side effects.

\ Studies conducted by the lead author A.K. Rajasekaran, director and head of the Membrane Biology Laboratory, and his team at Nemours, in collaboration with Xinqiao Jia, associate professor of materials science and engineering and biomedical engineering, and her team at UD, used polymeric nanoparticles containing chemotherapeutic agents to ensure controlled delivery of drugs to cancer cells in preclinical models.

Click here to read the entire story in UDaily.

CONSORTIUM MEMBER NEWS

We would like to thank **Honeywell Advanced Fibers and Composites**, **Colonial Heights, VA,** for becoming our newest consortium member. We also wish to thank **Chesapeake Defense Service, Belcamp, MD,** for the recent renewal of their membershipand for continuing to participate in our 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 39 years of significant contributions to composites science and technology, the education of students, and the creation and transfer of technology to industry.

39th Anniversary
1974-2013

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

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