UNIVERSITY OF MACAU
FACULTY OF SCIENCE AND TECHNOLOGY
DEPARTMENT of
ELECTROMECHANICAL ENGINEERING

Ref: FST/SEM/024/2010

(1) Shape Memory Polymer-based Composites for Self-healing Structural-length Scale Damage

by

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Louisiana State University, Baton Rouge, LA 70803, USA

Date: 25/05/2010 (TUESDAY)
Time: 03:30PM – 04:30PM
Venue: HG01 (University of Macau)

Abstract

1st Seminar
Shape Memory Polymer-based Composites for Self-healing Structural-length Scale Damage

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Self-healing of structural damage has been a tremendous interest in the scientific community recently. While the state-of-the-art one-step self-healing approaches such as micro-capsules, hollow fibers, micro-vascular systems, thermally reversible covalent bonds, ionomers, incorporation of thermoplastic particles, etc., are very effective in self-healing micro-length scale damage, self-healing of macro/structural-length scale damage remains one of the grand challenges facing the self-healing community. We believe that self-healing of structural damage may need multiple steps, at least two steps: seal then heal (STH), i.e., autonomously narrow/close the macrocracks before the existing micro-length scale self-healing schemes take effect, similar to the biological healing of wounds in the skin. To this end, we propose to use the shape recovery functionality of shape memory materials for sealing and thermoplastics for healing. As a proof-of-concept study, a shape memory polymer (SMP) based syntactic foam is fabricated, programmed, and repeatedly impacted and sealed. Its capability for efficiently and effectively sealing impact damage is demonstrated. A thermodynamics based phenomenological model is developed to predict the constitutive behavior of the foam. The predictability of the model is validated by experimental thermomechanical characterizations. Application of the smart foam to a lightweight grid stiffened syntactic foam cored sandwich is also investigated. In order to validate the two-step STH self-healing scheme, a particulate-filled composite with thermoplastic particles dispersed in the SMP matrix is fabricated, programmed, notched, and repeatedly fractured and healed, with satisfactory results.

Brief Biography of Dr. Guoqiang Li

Guoqiang Li, Ph.D.
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Dr. Guoqiang Li received his Ph.D. degree in Civil Engineering from Southeast University in 1997. Currently, he is the National Science Foundation Joint Faculty Appointment Program (JFAP) Associate Professor of Mechanical Engineering at both Louisiana State University (LSU, the Flagship University in Louisiana) and Southern University (SU, the Largest HBCU in Louisiana). He is a recognized expert in the composite materials research field. He has published/accepted 109 refereed journal papers, 4 book chapters, and over 70 conference proceedings/presentations. He has been the PI or Co-PI of about 50 research / education / enhancement grants, with a total funding over $16M. These

grants are funded by NSF, NASA, DoE, DoD, DoT, USDA, etc. His research/education projects have supported over 50 undergraduate students and over 20 graduate students. He has reviewed numerous papers for 31 archival journals, and many proposals for 3 federal funding agencies and 1 book publisher. He is currently serving on the editorial board, as an associate editor, or as a guest editor for 5 archival journals, and has served as chair, session developer, committee member, and distinguished speaker in technical committee or conferences. Dr. Li has received 18 national/regional/local awards in research, education, and service, including: “2010 Louisiana State University Alumni Association Faculty Excellence Award”, “2009 National Role Model Faculty Researcher Award”, “2008 Society of Plastic Engineers (SPE) Composites Division Educator of the Year Award”, “2007-2008 Southern University Outstanding Research Investigator Award”, “2007 Southern University Excellence in Research Mentoring Award”, “2006-2007 Southern University College of Engineering Researcher of the Year Award”, “2005-2006 Southern University Young Research Investigator Award”, “2003 Louisiana State University Outstanding Mentor Award by LS-LAMP”, “2002 ASME Frank Walk Service Award (American Society of Mechanical Engineers/Petroleum Division)”, “2001 ASME Eckart Service Award (American Society of Mechanical Engineers/Petroleum Division)”, and “2001 ASME Ten Paper Cup Award (American Society of Mechanical Engineers/ Petroleum Division)”.

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(2) Louisiana State University/Southern University NASA Project on Smart Adhesively Bonded High-Performance Joint for Composite Structures

Date: 25/05/2010 (TUESDAY)
Time: 04:30PM – 05:30PM
Venue: HG01 (University of Macau)

by

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Ph.D., P.E., Fellow-ASME, SPE, AAAS
(Honorary Doctorate -- Doctor of Science honoris causa, University of Macau, China)
Associate Vice Chancellor for Strategic Initiatives and
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Dr. Guoqiang Li
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2505C Patrick F. Taylor Hall,
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Abstract

2nd Seminar

Louisiana State University/Southern University NASA Project on Smart Adhesively Bonded High-Performance Joint for Composite Structures

Dr. Su-Seng Pang and Dr. Guoqiang Li
Department of Mechanical Engineering
Louisiana State University
Baton Rouge, LA 70803, U.S.A.

This NASA EPSCoR Research Project was funded by NASA and Louisiana Board of Regents. It was initiated in October 1, 2007. This collaborative project brings together researchers from Louisiana State University (LSU) and Southern University that will provide exciting new results for NASA along with developing an important new capability in Louisiana, U.S.A. The team combines experienced faculty with young researchers to provide a mentoring relationship designed to build research capacity at both institutions and bring the younger team members into prominence. This project was developed after seed support provided by Space Grant and EPSCoR and is a natural evolution from these programs. The goal of this three-year NASA/EPSCoR project is to provide NASA with durable, reliable, and intelligent adhesively bonded composite joints, and enhance the NASA-missions as well as the related research infrastructure and workforce training in Louisiana. The research objectives are to: (i) dramatically and self-adaptively reduce peel/shear stress concentrations at the adhesive bondline, (ii) self-monitor, self-control, and self-heal the composite joint system *in-situ*, and (iii) extend the service life of aged/aging aircraft. The education objective is to develop a research-oriented approach designed to attract and retain a greater number of high caliber students, including minority students, in Science, Technology, Engineering and Mathematics (STEM) disciplines, and to provide a well-trained workforce for Louisiana and for NASA and related industries. Four research tasks are included in this project: (1) Theoretical modeling and optimization; (2) Subcomponent material selection, fabrication and characterization; (3) Development of Fabrication technology; and (4) Experimental testing and validation. Strategies for project management and educational outreach will also be discussed in the seminar.

Brief Biography of Dr. Su-Seng Pang

Su-Seng Pang, Ph.D., P.E., Fellow-ASME, SPE, AAAS
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Dr. Su-Seng Pang received his Ph.D. degree in Mechanical Engineering from U.C. Berkeley in 1987. Currently, he is the Associate Vice Chancellor for Strategic Initiatives and Jack Holmes Distinguished Professor of Mechanical Engineering at Louisiana State University (LSU). Dr. Pang is a Fellow of three professional societies: American Society of Mechanical Engineers (ASME), Society of Plastics Engineers (SPE), and American Association for the Advancement of Science (AAAS). He is a recognized expert in the composite materials research field. Dr. Pang has published over 200 journal papers/conference proceedings in the areas of composite materials and structures, pressure vessel and piping, and various joining technologies. He has been the Principal Investigator (PI)/Co-PI of over 100 projects funded by NSF, NASA, Navy, Army, Air Force, Department of Energy, and various industries; 20 of those are still on-going. His research/education projects are now supporting over 300 college students per year as well as numerous high school teachers and students. Since 1996, Dr. Pang has received 34 U.S. national/regional awards in research and education, including: AAAS National Mentor Award; Presidential Award for Mentoring (at the **White House**); Tibbetts Award for SBIR Model of Excellence (at the **White House**); ACAP Distinguished Achievement Award; AACP Outstanding Achievement Award; **Minority Access National Faculty/Administrator Role Model Award**; ASME International Board on Minorities and Women Award; Carnegie/CASE Louisiana Professor of the Year; ASEE National Minorities in Engineering Award; etc. Dr. Pang has also received many recognitions from his university, including: LSU Rainmakers Award for Research and Creative Faculty; LSU Making the Difference Award; LSU Award for Faculty Excellence; LSU Distinguished Faculty Award; LSU Alumni Association Faculty Excellence Award; LSU Engineering Excellence Mentor Award; and LSU Engineering Outstanding Faculty Service Award. Currently, Dr. Pang is serving as: (i) Board of Directors Member for the Association of Chinese-American Professionals and Applied Polymer Technology Extension Consortium; (ii) External Evaluator for the National Science Foundation/HBCU-UP Project at South Carolina State University; (iii) Technical

Advisory Committee Member, NASA EPSCoR Program for Louisiana; (iv) External Evaluator for LSAMP-The Georgia Louis Stokes Alliances for Minority Participation Program; and (v) Accreditation Evaluation Team Member for Southern Association of Colleges and Schools, LSU Civil and Environmental Engineering Program.

ALL ARE WELCOME!