Composites under Harsh Environments

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The work presents an overview of the current state of the art in low temperature effects on materials in terms of durability and safety of vehicles. Susceptibility of composites to failure at low temperature is a critical issue for the aerospace industry. Space crafts operate at temperatures well below -200 ^{o}C. High altitudes aircrafts routinely fly at -70 ^{o}C to -100 ^{o}C. These low temperatures result in two competing effects on composite stiffness. One beneficial effect involves increased stiffness because the polymer matrix would harden at low temperature. The other detrimental effect involves increased thermally-induced stress, which produces microcracks in matrix, which in turn, reduces the overall stiffness of the composites. These two competing beneficial-detrimental phenomena at the microstructure level have been studied for decades, but a quantitative understanding of the interplay of these two effects has continued to elude the researchers. Additional complexities arise when the stiffness increase effect is considered because of high strain rate loading. Long term exposure to cyclic or vibration can again reduce the stiffness. The competing effects for fatigue of fiber-reinforced polymer composites at low temperatures will be presented. Emphasis will be on civil engineering structural and other involving earthquake applications, orthogrids, FRP rebars, sandwich structures, guardrails, piers and structural members.

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Dr. David Hui is Professor of Mechanical Engineering and director of Composites Materials Research Laboratory at University of New Orleans. He received his Ph.D. from University of Toronto in Aerospace Engineering, and Master of Science from Massachusetts Institute of Technology. He is Honorary Professor at Chongqing University, Harbin Institute of Technology, Huazhong University of Science and Technology, Southwest Jiaotong University, Shanghai University, Guizhou University; Visiting Professor at Central South University, Fudan University, Shanghai Jiaotong University, Tongji University, Southeast University, Nanjing; *Doctor Honoris Causa* at Kherson National Technical University, Ukraine, Vietnamese Academy of Science and Technology, University of Salerno, Italy, Saigon Technology University, Vietnam; Member of Georgia, Serbia and Armenia Academy of Engineering.

Dr. Hui has edited over 40 widely cited books. He is founder and editor-in-chief of the journal Composites B Engineering and serves in the editorial board of 11 SCI journals on composite materials. Dr. Hui is ASME Fellow, ICCE Life Member, AIAA Associate Fellow and CASI Associate Fellow. He was awarded by The Ohio State University Research Award, ASME Pressure Vessels and Piping Certificate of recognition, ASME Ralph James Award (ASME Petroleum Division), NASA Certificates of Recognition, ASME ETCE Service Awards, the University of New Orleans Research Achievement Award. He is the chairman of ICC – International Conference on Composite Materials. Dr. Hui has co-authored over 220 SCI journal publications cited over 3000 times.

One of Dr. Hui's outstanding contributions is the modeling of penetration of composite materials using the energy partition model and functional graded approach to enhance the durability and safety of engineering structures under harsh environments. His pioneered research on the mechanisms of degradation of materials under low temperatures on composites has resulted in enormous improvement in the safety of engineering structures, and collaboration with US Army Cold Regions research and Engineering Lab of the Dept. of Defense, USA.

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