

The Department of Mechanical Engineering/College of Engineering and Applied Sciences
Stony Brook University

Mechanical Engineering Seminar



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Lecture Title: Energy Conversion Devices with High Efficiency for Actuation and Harvesting

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Abstract

Energy conversion devices, such as piezoelectric and electrostrictive materials-based actuators, sensors, and transducers, have demonstrated great feasibilities and capabilities during the last three decades for mechanical control and energy harvesting. Nowadays, energy conversion devices become one of the emerging technology areas because of the incremental challenging requirements from the military, NASA, aerospace, medicine, and automobile industries. Although great efforts have been made in developing functional materials and devices, technical challenges still exist, including larger stroke actuators with higher load capabilities and faster response, high energy efficiency cryogenic actuators, high efficiency broadband energy harvesting transducers. In order to address those challenging issues, we have developed several kinds of new functional materials and invented a number of new devices for energy conversions between electrical and mechanical formats. I will briefly introduce the needs of energy conversion devices for mechanical control and energy harvesting, and then, present the details of our innovations. Starting with the fundamental properties of piezoelectric and electrostrictive materials considerations, the innovations for hybrid actuation system, hybrid piezoelectric energy harvesting transducer, cryogenic actuators, and multistage amplification transducers will be described. The theoretical predictions, experimental validations, and movie demonstrations for those devices will be presented/displayed. In addition, an introduction for NIA and NASA/LaRC will be given at the beginning of this talk.

Biography

Dr. Tian-Bing Xu is a Senior Research Scientist at the National Institute of Aerospace (NIA), which is affiliated with NASA Langley Research Center (NASA/LaRC). He has been working at NASA/LaRC since January 2002. Dr. Xu received his M.S. in Electrical Engineering in 1999 and Ph.D. in intercollege program in Material in 2002 from Pennsylvania State University. He is also an adjunct professor of Mechanical and Aerospace Engineering at Old Dominion University. Dr. Xu's current research interests are in the areas of smart materials and structures (transducers, actuators, and sensors) with applications in energy harvesting, aerodynamic control, space propulsion system, and green aircraft. In his ten-year career at NASA/LaRC, Dr. Xu has been involved in numerous projects on developing advanced materials and devices for aeronautics and aerospace applications. He has been the leader for 11 NASA/LaRC and NIA projects, managing/co-managing over \$2.5 million dollars in research funding. Dr. Xu holds 12 issued and pending U.S. patents, and has 8 additional U.S. patent applications in process. During the last four years, he has contributed 10% of the patent applications for the entire NASA/LaRC. His inventions on energy harvesting devices were recognized by DOE and NASA. He authored and coauthored 48 papers in peer-reviewed journals. In addition, Dr. Xu has received 18 awards from NASA Headquarters, NASA/LaRC and NIA.