Applications to Gas Turbines – Health Monitoring

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ABSTRACT

The gas-turbine engine has been the focus of intense research since the first Whittle design in 1937. Although it has evolved into a very efficient source of power many areas remain open for advances. Many such advances however require instrumentation for monitoring and controlling transient phenomena. In particular, instrumentation needs are for distributed phenomena across the system, subsystems, components, ... , which require spatially fine resolution at the local points. Microelectromechanical systems (MEMS) is a natural enabling technology to meet these instrumentation challenges. MEMS enable the development of smart systems by augmenting the computational ability of microelectronics with the perception and control capabilities of microsensors and microactuators.

The lecture will provide a review of instrumentation needs in gas turbine engine development where MEMS technology has been, is being, or is envisioned to be pursued. In the context of these pursuits, the specific MEMS research and development will be highlighted. The instrumentation (e.g., sensors, actuators, and control circuits) for the gas turbine applications must operate in high temperature environments compared to more pedestrian applications (i.e., in addition to many other harsh environment factors in a gas turbine engine). SiC MEMS technology holds great promise for applications which are characterized by presence of harsh environments (e.g., high temperatures, large number of vibrational cycles, erosive flows, and corrosive media). The lecture will introduce and review the state of SiC MEMS technology in the context of gas turbine engine instrumentation needs.

BIOGRAPHY

Mehran Mehregany received his B.S. in Electrical Engineering from the University of Missouri in 1984, and his M.S. and Ph.D. in Electrical Engineering from Massachusetts Institute of Technology in 1986 and 1990, respectively. From 1986 to 1990, he was a consultant to the Robotic Systems Research Department at AT&T Bell Laboratories, where he was a key contributor to ground-breaking research in microelectromechanical systems (MEMS). In 1990, he joined the Department of Electrical Engineering and Applied Physics at Case Western Reserve University as an Assistant Professor. He was awarded the Nord Assistant Professorship in 1991, was promoted to Associate Professor with tenure in July 1994, and was promoted to Full Professor in July 1997. He held the George S. Dively Professor of Engineering Endowed Chair from January 1998 until July 2000, when he was appointed the BFGoodrich Professor of Engineering

Paper presented at the RTO AVT Lecture Series on "MEMS Aerospace Applications", held in Montreal, Canada, 3-4 October 2002; Ankara, Turkey, 24-25 February 2003; Brussels, Belgium, 27-28 February 2003; Monterey, CA, USA, 3-4 March 2003, and published in RTO-EN-AVT-105.

Innovation. He served as the Director of the MEMS Research Center at CWRU from July 1995 until July 2000. Professor Mehregany is well known for his research in the area of MEMS, and his work has been widely covered by domestic and foreign media. He has over 200 publications describing his work, holds 12 U.S. patents, and is the recipient of a number of awards/honors. He served as the Editor-in-Chief of the Journal of Micromechanics and Microengineering from January 1996 to December 1997, and is Assistant-to-the-President of the Transducers Research Foundation. His research interests include silicon and silicon carbide MEMS, micromachining and microfabrication technologies, materials and modeling issues related to MEMS and IC technologies, and MEMS packaging.

Mehran Mehregany is the Founder and served as the President (July 1993 to March 1999) of Advanced Micromachines Incorporated (Cleveland, Ohio), a company in the MEMS area. Advanced Micromachines Incorporated was acquired by The BFGoodrich Corporation in March 1999. He founded NineSigma, Inc., an information technology company, in February 2000 and served as its CEO (June 2000 to January 2001) and CTO (January 2001 to August 2001), during which period he successfully completed initial rounds of private financing and grew the company to 15 employees. He co-founded FiberLead, Inc., an optical telecommunications company, in September 2000 and served as its CEO until September 2001, during which period he successfully completed the early stage round of venture capital financing and grew the company to 5 employees.