Carnegie Mellon

Materials Science and Engineering Seminar Series

Richard P. Gangloff

Department of Materials Science and Engineering
University of Virginia

"Environment Dominated Fatigue in Aluminum Alloys"

Friday, September 14, 2007
11:00 A.M. Seminar in Hamerschlag B131

Exposure to a moist environment degrades the fatigue resistance of all aluminum alloys, broadly attributed to hydrogen embrittlement, and introduces complex time-cycle dependent cracking behavior. This problem has been recognized for 100 years; however; alloy development, performance prognosis, and fundamental mechanism studies have not adequately addressed this damage mode. The importance of environment is demonstrated for fatigue crack initiation and propagation in precipitation hardened aluminum alloys. Modern methods to optimize resistance to such cracking are summarized, including: (a) fracture mechanics simulation of the effect of precorrosion on fatigue life, (b) environment exposure and process-rate limited modeling of crack growth kinetics, (c) high resolution experimental probes (such as SEM/EBSD and FIB/TEM) to characterize damage mechanisms, and (d) smart-ion inhibition of hydrogen uptake. These results show that there is much more to understanding and modeling fatigue than suggested by dislocation plasticity or continuum fracture mechanics approaches that dominate the field. From the environmental perspective, new opportunities for advances are apparent and tools are emerging to substantially improve alloy fatigue resistance.

RICHARD P. GANGLOFF is Ferman W. Perry Professor and Chair of the Department of Materials Science and Engineering at the University of Virginia in Charlottesville, positions that he assumed in 2003 after entering the university in 1986 as Associate Professor and serving as Professor from 1990. From 1980 to 1986 he was Senior Staff Metallurgist at the Corporate Research Science Laboratories of the Exxon Research and Engineering Company; and from 1974 to 1980, Metallurgist at the General Electric Corporate Research and Development Center. In these capacities he conducted research on fatigue and fracture problems in the nuclear, aircraft engine, airframe, marine, and chemical technologies. He received the B.S., M.S. and Ph.D. degrees in Metallurgy and Materials Science from Lehigh University between 1966 and 1974. Professor Gangloff is a member of ASM, AIME, ASTM, Sigma Xi and Tau Beta Pi. He is a Fellow of ASTM, a Fellow of ASM International, Past Chairman of the ASTM committee on Subcritical Cracking, editor of five international conference proceedings for AIME, NACE and ASTM, as well as organizer of the 1994 Gordon Conference on Physical Metallurgy and 1st International Conference on Environment-Induced Cracking of Metals. He has authored 110 invited lectures and 115 publications on the metallurgy, fracture mechanics and chemistry of fatigue and fracture in ferrous, zirconium, aluminum, nickel, and titanium alloys. He received the 1986 Henry Marion Howe Medal from ASM and the 1991 ASTM Award of Merit for work in these fields, and was the 1996 ASTM Fatigue Lecturer. From 1987 through 2000, Professor Gangloff directed the NASA-UVa Light Aerospace Alloy and Structures Technology Program at UVa. He has consulted for 35 companies and government laboratories.