Symposia Summary

Ultrasonic Fatigue of Advanced Materials and Systems

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Many engineering systems, such as jet engine parts, vehicle or offshore structures as well as MEMS structures, have to resist more than 10 million cycles due to very high operation frequencies or an expected lifetime of up to 30 years and more. The intended increase of economic efficiency is a driving force for the design of new components and systems operated in the Very High Cycle Fatigue (VHCF) regime with nearly infinite lifetimes.

The main focus of this symposium was the improvement in understanding of the mechanisms of fatigue for different groups of engineering materials in the very high cycle fatigue regime (VHCF). This first full day symposium on this topic encompassed the newest developments, innovations and results in the emerging field of ultrasonic fatigue. Eleven scientific contributions, one keynote, and two invited lectures were offered by experts and young researchers from the United States, Japan, Germany, Austria, Sweden and France.

An overview of the diversity of the fatigue mechanisms was first presented for “model” materials like pure copper, aluminum or nickel as well as for the most important structural materials such as high-strength steels, aluminum, titanium and nickel-base super alloys. The remainder of the symposium was dedicated to composite materials with metal (AMC) and polymer matrix (CFRP). The fatigue behavior of micro-electro-mechanical-systems (MEMS) and thin films under complex cyclic loading conditions were also covered.

Additional highlights were the introduction of a new ultrasonic testing facility for CFRP and the use of new, mainly in-situ, experimental techniques during ultrasonic fatigue loading. Examples included the application of digital image correlation (DIC) at ultrasonic frequencies, scanning laser vibrometry, synchrotron x-radiography, and the use of nonlinear ultrasonic techniques.

The damage mechanisms of metal failure in the VHCF regime were clearly pointed out in the keynote lecture by Martina Zimmermann,University of Siegen, Germany, who noted that fatigue life is dominated by the crack initiation phase rather than by crack growth. Major roles, especially, for quasi-defect free metals are ascribed to microstructural inhomogenities resulting in locally different elastic and plastic deformation behavior. Discontinuities act as local stress raisers or decrease the resistance to slip transmission across or along grain/phase boundaries.

Based on this first very successful symposium, a special issue on ultrasonic fatigue of advanced materials will be published in the Elsevier journal, *Ultrasonics*, edited by Frank Ball, symposium organizer. The submission for reviews and regular papers is open until September 30, 2012 via http://www.journals.elsevier.com/ultrasonics

—Submitted by Frank Balle