ME Seminar

Mechanics of Dynamic Crack Penetration vs. Branching at Weak Interfaces in Elastically Homogeneous (Transparent) Bilayers

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ABSTRACT

In this presentation, dynamic crack-interface interactions and the mechanics of crack penetration vs. branching at a weak interface are discussed. The interfaces in elastically homogeneous bilayer architectures are oriented perpendicular to incoming mode-I cracks. The effect of interface location and the associated crack-tip parameters on the mechanics of ensuing fracture behaviors are examined. Time-resolved full-field optical measurements of crack-tip deformations, velocity and stress intensity factor histories in different bilayer configurations are performed using the Digital Gradient Sensing (DGS) technique in conjunction with ultrahigh-speed photography. The results show that the crack path selection at the interface are influenced by the location of the interface within the bilayer geometry. Using measured instantaneous fracture parameters, the mechanics of crack penetration vs. crack branching is explained and visualized. Counter to the intuition, a dynamically growing mode-I crack approaching a weak interface with a lower velocity and stress intensity factor penetrates the interface without branching whereas a higher velocity and stress intensity factor counterpart gets trapped by the interface producing bifurcated daughter cracks until they kink into the next layer as mixed-mode cracks.

ABOUT THE SPEAKER

Dr. Hareesh Tippur is McWane Endowed Chair Professor of Mechanical Engineering at Auburn University, Alabama. He received post-graduate degrees from the Indian Institute of Science and State University of New York at Stony Brook (Stony Brook University). He was a post-doctoral fellow of Aeronautics at the California Institute of Technology before joining Auburn University. He is credited with the development of several quantitative full-field visualization techniques for studying the mechanics of solids. He has worked extensively on experimental fracture and failure mechanics of solids with an emphasis on high-strain rate behavior of materials. To date his research has resulted in over 250 publications in peer reviewed journals and conference proceedings and he has mentored over forty PhD and MS students to completion. Several US federal agencies including NSF, DOD and NASA have sponsored his research over the years. He has received accolades from professional societies including the Society for Experimental Mechanics, American Society of Mechanical Engineers, British Society for Strain Measurement and American Society of Engineering Education. Previously he has served as the Editor-in-Chief of the journal, Experimental Mechanics.

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