LMS Seminar

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Anomalous toughness of elastic micro-architected solids

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ABSTRACT

Rapid progress in additive manufacturing methods has led to the creation of a new class of architected metamaterials that comprise of a network of struts resembling a periodic truss structure. The mechanical performance these materials is ultimately limited by their tolerance to damage and defects. Yet, manufacturing limitations has meant that experimental investigations of the toughness of these materials have remained elusive. Using architected material specimens comprising millions of unit-cells we show that not only is stress intensity factor, as used in conventional elastic fracture mechanics, insufficient to characterise fracture in these architected materials but also that conventional fracture testing protocols are inadequate. In fact, remarkably, these materials made from elastic-brittle parent solid show steeply rising R-curves and resemble those of highly ductile solids. The implications of these findings for interpreting the measured toughness's of biological cellular solids such as bones will also be discussed.

BIOGRAPHY

Vikram Deshpande joined the faculty of Engineering at the University of Cambridge as a lecturer in 2001 and was promoted to a professorship in Materials Engineering in 2010. He has also served on the faculties at the University of California, Santa Barbara and at the Technical University of Eindhoven. His work is primarily in experimental and theoretical solid mechanics. He serves on the editorial boards of several journals in mechanics and biomechanics. He has been awarded the 2020 Rodney Hill Prize in Solid Mechanics, the 2022 Prager Medal and the 2022 ASME Koiter medal. He is a Fellow of the Royal Society, London and an International member of the US National Academy of Engineering.