

# DEPARTMENT OF MECHANICAL ENGINEERING

## WILLIAM MAXWELL REED SEMINAR SERIES

### “Fracture of Heterogeneous Materials”

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**Abstract:** Heterogeneous materials are ubiquitous in the form of composites and are widely used in engineering structures. Heterogeneities can be leveraged to increase fracture toughness by redistributing the stresses, such as by impeding crack propagation. While there exists a good understanding of the effective elastic properties, relatively less is known concerning the effective toughness of heterogeneous materials. The fracture of heterogeneous solids is explored experimentally using a model system of peeling an adhesive tape from a rigid substrate. This problem is used to illustrate the complexities that can arise due to the interplay between elasticity, adhesion, and heterogeneity. It is shown that one can enhance the overall adhesive strength by patterning the elastic modulus of the tape or the adhesive energy of the substrate. Extensions of the ideas of enhancing toughness from peeling to engineered composites that are additively manufactured are discussed. Experimental measurements are used to separate the effects of the deformation caused by inclusions/voids in a composite from the effect of passing through an interface during crack propagation. Phase-field modeling and numerical simulations are used to gain insights on the role of elastic modulus and toughness contrast on fracture resistance in heterogeneous materials.

**Bio:** Guruswami (Ravi) Ravichandran is the John E. Goode, Jr. Professor of Aerospace and Mechanical Engineering and Otis Booth Leadership Chair of the Division of Engineering and Applied Science at the California Institute of Technology. He received his B.E. (Honors) in Mechanical Engineering from the University of Madras, Sc.M. in Engineering and Applied Mathematics and Ph.D. in Engineering (Solid Mechanics and Structures) from Brown University. He is a member of the National Academy of Engineering, Academia Europaea, International Academy of Engineering, and European Academy of Sciences and Arts. He is a Fellow of the American Society of Mechanical Engineers (ASME), Society for Experimental Mechanics (SEM) and American Academy of Mechanics (AAM). He was named Chevalier de l'ordre des Palmes Academiques by the Republic of France. His awards include A.C. Eringen Medal from the Society of Engineering Science, Warner T. Koiter Medal from ASME, and William M. Murray Lecture Award from SEM. His research interests are in mechanics of materials including deformation, damage and failure, micro/nano mechanics, wave propagation, composites, active materials, biomaterials and cell mechanics, and experimental methods.

**Date:** Friday, Nov. 15<sup>th</sup>

**Place:** CB 106

**Time:** 3PM

**Contact:** Dr. Alexandre Martin 257-4462

Meet the speaker and have refreshments

Attendance open to all interested persons