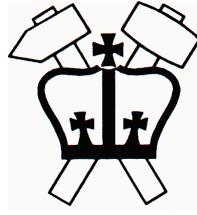


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Cracking the Conch Conundrum: Tough Ceramics at the Seashore

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Natural composite materials are renowned for their mechanical strength and toughness; despite being highly mineralized, with the organic component constituting not more than a few percent of the composite material, the fracture toughness exceeds that of single crystals of the pure mineral by two to three orders of magnitude. The judicious placement of the organic matrix, relative to the mineral phase, and the hierarchical structural architecture extending over several distinct length scales both play crucial roles in the mechanical response of natural composites to external loads.

In this talk experimental and theoretical results are first used to show that the resistance of the shell of the conch *Strombus Gigas* to catastrophic fracture can be understood quantitatively by invoking two energy-dissipating mechanisms: multiple cracking in the outer layers at low mechanical loads, and crack bridging in the shells tougher middle layers at higher loads. Both mechanisms are intimately associated with the so-called crossed lamellar microarchitecture of the shell, which provides for tunnel cracking in the outer layers and uncracked structural features that bridge crack surfaces, thereby significantly increasing the work of fracture, and hence the toughness, of the material. Despite a high mineral content of about 97% (by volume) of aragonite, the shell of *Strombus Gigas* can thus be considered ceramic plywood (albeit plywood fails in a different manner than the shell), and can guide the bioinspired design of tough, lightweight structures.

The talk ends with descriptions of *Strombus gigas* ability to repair load-induced damage, of modest attempts to mimic the structure of seashells, and incorporation of self-healing processes in synthetic composites.

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3:00 - 4:00 p.m.
Room 627, Mudd

<http://www.civil.columbia.edu/~ling/seminar>