Close Window

Print

Submitted

on June 16, 01:11 PM

for mrsfall2009

Proof

CONTROL ID: 667087

CONTACT (NAME ONLY): Christine Ortiz

Abstract Details

PRESENTATION TYPE: Invited Speaker

SYMPOSIUM: QQ: Responsive Gels and Biopolymer Assemblies

KEYWORDS: Composition & Microstructure / Material Type / biological, Properties / Mechanical / elastic properties, Properties / Mechanical / toughness.

Abstract

TITLE: Bio-organic Armor in Nature

AUTHORS (FIRST NAME, LAST NAME): Christine Ortiz[1]

INSTITUTIONS (ALL): 1. Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA, USA.

ABSTRACT BODY: Biological exoskeletons or "natural armor" are multilayered, hierarchical structures that serve many functions, in particular protective mechanical roles such as; penetration, wear, and scratch resistance, minimization of back deflection and potential blunt trauma, damage detection and sensing, self-repair and regeneration, and, in certain cases, flexibility and mobility. In many natural armor systems, purely organic layers exists either externally to mineralized layers (e.g. the periostracum in molluscs), alternating with mineral layers internally (e.g. the chintophosphatic shell of brachiopods), or more rarely between two mineralized layers forming a stiff(hard)–compliant(ductile)-stiff(hard) sandwich design (Crysomallon squamiferum, a hydrothermal vent mollusc). These organic conchiolin layers are cross-linked, proteinaceous, and possess a diversity of morphologies (e.g. multilayered, lamellar, fibrous, hairy, etc.). They are known to act as a template for shell mineralization and possibly serve as protection from harsh corrosive and dissolutive marine environments (e.g. brackish, cold-water, low pH conditions), as well as chemical protection from boring secretions. It is hypothesized that bioorganic layers may serve a role in thermal regulation and are also mechanically advantageous. This talk will discuss the structure-property relationships of such layers and focus on their contribution to the mechanical performance of an entire biological exoskeletal structure, an effect that will be significant, for example, for thick periostraca such as those found in the antarctic snail, Torellia mirabilis and the hydrothermal vent mollusc, Alvinoconcha hessleri. The mechanical properties of selected bioorganic layers will be presented, as measured by instrumented nanoindentation and microhardness experiments. It was determined that the bioorganic armor layers of selected model systems were approximately an order of magnitude more compliant and more ductile than neighboring mineralized layers, and did not undergo fracture as mineralized layers did for the same maximum load. In addition, bioorganic layers consistently arrest cracks propagating from the neighboring mineralized layers. Studies of bioorganic coatings with such a unique combination of mechanical, thermal, and chemical properties are relevant to such industries as; semiconductor, oil and gas, textiles, defense, and construction.

(No Table Selected)