

Author's Accepted Manuscript

The mechanical behavior of nacre across length scales

Hariprasad Gopalan, Atul H. Chokshi



PII: S1751-6161(17)30446-0
DOI: <https://doi.org/10.1016/j.jmbbm.2017.10.018>
Reference: JMBBM2538

To appear in: *Journal of the Mechanical Behavior of Biomedical Materials*

Received date: 19 May 2017
Revised date: 13 September 2017
Accepted date: 12 October 2017

Cite this article as: Hariprasad Gopalan and Atul H. Chokshi, The mechanical behavior of nacre across length scales, *Journal of the Mechanical Behavior of Biomedical Materials*, <https://doi.org/10.1016/j.jmbbm.2017.10.018>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting galley proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

The mechanical behavior of nacre across length scales

Hariprasad Gopalan*, Atul H. Chokshi

Department of Materials Engineering, Indian Institute of Science, Bangalore

*Corresponding author: email: hari@platinum.materials.iisc.ernet.in, Tel no: 91-080-22932684,

Fax: 91-080-2360 0472

Abstract

Nacre achieves excellent mechanical properties with a relatively simple hierarchical structure. Analyses suggest that a significant gain in toughness is realized with a modest reduction in strength, with increasing levels of hierarchy. This study probes the role of different hierarchical length scales in governing the strength and modulus of nacre using a combination of bulk compression tests, microindentation and nanoindentation tests. The variability in the measured properties is assessed through Weibull analyses. The transition from elastic deformation is characterized using spherical indentation tests at the micro and nano scales together with a Hertzian analysis. The modulus of the organic phase at different scales was deduced using indentation data and appropriate micromechanical models. The results show a minimal influence of length scales on elastic-plastic transitions, suggesting that initiation of plasticity occurs through a common biomineral sliding mechanism across length scales. However the ultimate strengths follow the trends of models for hierarchical materials, with the strength reducing by a factor of ~ 2 with each increase in level of hierarchy. The modulus of the organic phase was higher at the lowest scale, in contrast to an earlier study, indicating that confinement significantly modifies the effective properties of the organic.

Keywords: Nacre, hierarchy, strength, modulus, inter-tablet and trans-tablet organic

Download English Version:

<https://daneshyari.com/en/article/7207294>

Download Persian Version:

<https://daneshyari.com/article/7207294>

[Daneshyari.com](https://daneshyari.com)