上海大学 2020年
第三届本科生学术论坛

THE THIRD UNDERGRADUATE ACADEMICFORUM OF
SHANGHAI UNIVERSITY IN 2020

论文题目： **Computation Methods for Applied Mechanics Problem**

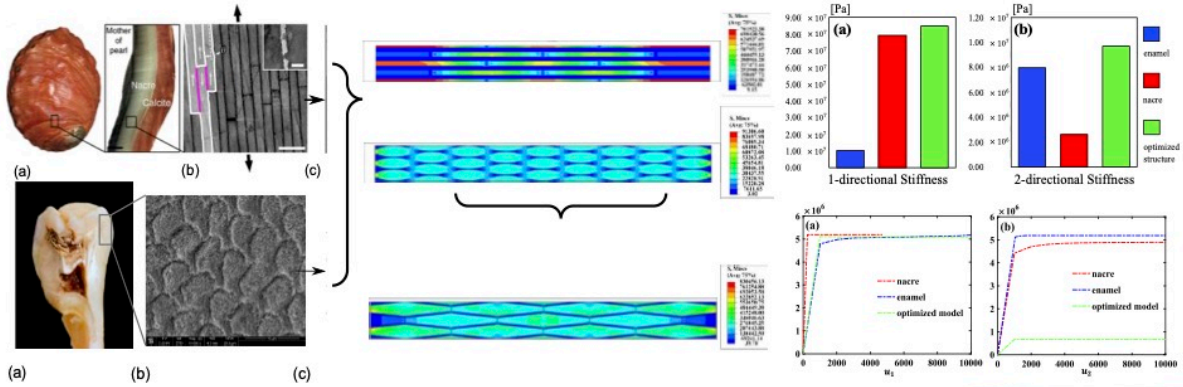
Structural Designation of Composite Materials with Superior Mechanical Behaviors: Lesson from the Microstructure of Nacre and Enamel

作　　者：翟晗锋

指导老师：

学　　院：力学与工程科学学院

Biomaterials display spectacular mechanical properties such as high stiffness, high strength, high toughness, and fracture durability. Such properties are exhibited by their natural developed structures, both employ common characteristics: consisting of hard mineral inclusions and soft protein matrix. Here, we build models, representative, for nacre, and enamel consisting of hard inclusions and soft matrix, respectively. We give the soft matrix a plastic property based on their natural mechanics. We thence calculate the 1 and 2-directional stiffness of the two structures and present their von Mises' stress, directional stress, and directional strain distribution, respectively. We estimate the fracture resistance of the two structures based on the assumption that the failure occurs on the soft matrix in which the shear stress reaches a critical value. We hence deduce that the nacre displays better 1-directional stiffness and enamel displays better 2-directional stiffness. The shear stress-displacement diagrams in each direction are also presented indicating the nacre is more likely to fail in 1-direction and enamel is more likely in 2-direction. Based on the results we present an optimized model taking the characters from both the nacre and enamel. Results show that the optimized model exhibits higher stiffness in both the two directions and evidently better crack resistance in 2-direction.



未来已来，聚创时代