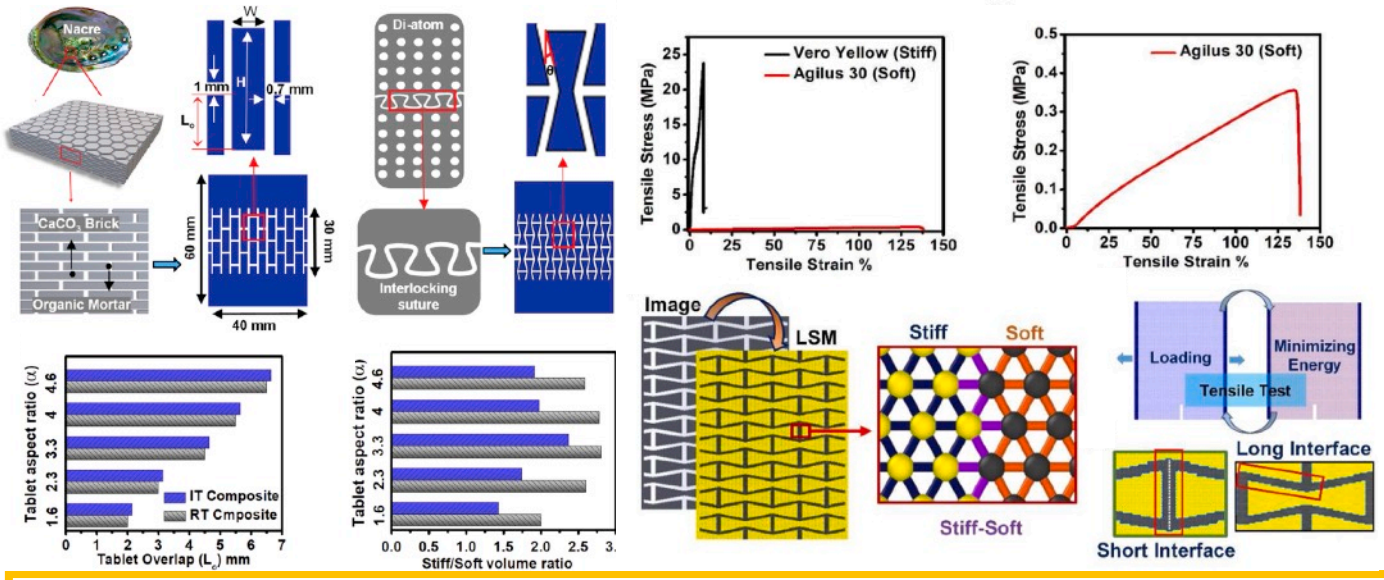
Lessons from Nature: Design and Fabrication of Bio-inspired/A.I.-optimized Materials with Synergistic Mechanical Performance

師法自然：具加承機械性能之生物啟發/人工智慧材料之設計與製造



Abstract

Natural materials, which have risen from billions of years of evolution, have developed unique characteristics, such as hierarchical structures, multi-functionality, self-assembly at ambient temperature and pressure, capabilities of self-healing and environmental adaptation. Distinct from engineering materials, which are unable to perform both lightweight and high strength; high stiffness and high toughness, biological materials are often composites of hard/brittle minerals and soft/ductile proteins arranged into complex hierarchical structures which possess remarkable mechanical properties, combining lightweight, high strength and high toughness owing to strengthening and toughening mechanisms from nano-, micro-, meso-, and macro-scales. Learning from Nature can lead to revolutionary breakthrough and innovation in materials science and technology. In this talk, selected biological materials, including mollusk shells, arthropod exoskeletons, dragonfly wings, bird feathers and bones will be introduced. Inspired from the structural designs of these natural materials, we further applied multi-scale simulation/modeling, genetic algorithm, machine learning, and A.I.-related approaches to optimize the bio-inspired structures and validated by 3D printing and mechanical testing. Novel structural materials and composites inspired from Nature and optimized by A.I. could lead to wide potential applications in industrial fields, including bicycles, automobiles, aerospace, intelligent robots, biomedical materials and assistive devices.

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