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Keynote Paper

# Bioinspired Structural Materials: Modeling and Design

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## 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. For nature and engineering materials, macroscopic mechanical properties are often influenced by its materials intrinsic properties and underlying microstructures. When the materials selection is limited, as situation often encountered in nature, control of microstructures becomes a vital way to evolve and enhance the performance of mechanical behavior. Furthermore, as such mechanisms originate from microstructures, they are transferable and can be adapted to other materials to increase desirable mechanical properties. In this keynote talk, I will present a modeling framework for designing bioinspired structural materials with tailored mechanical properties. Important design elements such as cellulous structures, hierarchical structures and composite and their influence on macroscopic mechanical properties such as stiffness, strength and toughness will be discussed. The future promise on using machine learning to facilitate bioinspired structural materials design will also be addressed.

## REFERENCES

1. T-H Huang, T-H Huang, Y-S Lin, C-H Chang, P-Y Chen, S-W Chang, C-S Chen (2018) "Phase-Field Modeling of Microstructural Evolution by Freeze-Casting," Advanced Engineering Materials, 20(3), 1870007. (Cover Image)
2. T-H Huang, C-S Chen, S-W Chang (2018), "Microcrack Patterns Control the Mechanical Strength in the Biocomposites," Materials and Design, 140, 505–515.

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