

# Accepted Manuscript

Mechanics of mutable hierarchical composite cellular materials

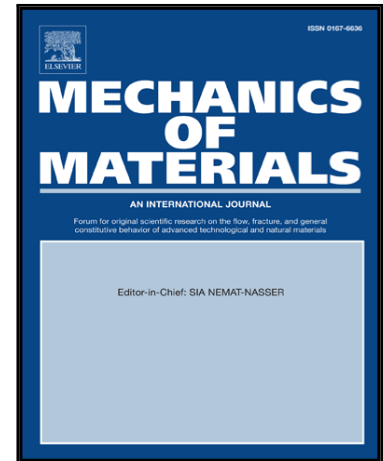
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**Highlights**

- This paper, inspired by the conformation of the hygroscopic keel tissue of the ice plant, deals with the analysis of a two-dimensional cellular material made of elongated hexagonal cells filled with an elastic material.
- The assumption of the Born rule, in conjunction with an energy-based approach, provide the constitutive model in the continuum form.
- It emerges a strong influence of the infill's stiffness and cell walls' inclination on the macroscopic elastic constants. In particular, parametric analysis reveals the system isotropy only in the particular case of regular hexagonal microstructure.
- The application of the theoretical model to estimate the effective stiffness of the biological system leads to results that are in good agreement with the published data, where the keel tissue is represented as an internally pressurised honeycomb. Optimal values of pressure and cell walls' inclination also emerge.
- Finally, the theory is extended to the hierarchical conformation and a closed form expression for the macroscopic elastic moduli is provided.

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