Poster Session | F. From Microstructure to Properties: Mechanisms, Microstructure, Manufacturing

[PO-F1]Poster Session 1

Symposium F

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[P1-49]Switching of coordinate transformations of a repetitive bar-and-joint framework under uniaxial compression

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In recent years, a variety of artificial microstructures with multi-functionality have been extensively developed by incorporating specific geometric features. The topic appears in a wide range of fields from geometry to crystallography to engineering, and indeed the mechanical behaviors of many of these structures remain unexplored. Some examples of such behaviors include auxeticity in materials of negative Poisson’s ratio, origami-based folding and deployment, and deformability of hierarchically arranged structures. In this context, we proposed the compressive structural system switching two types of kinematic transformations toward diamond- and square-patterns. To clarify the transition mechanism, we modelled a specific repetitive bar-and-joint framework with the two angular variables specifying the rotation and distortion of the linked square components. Numerically exploring the equilibrium paths then reveals a transition state of the structure at a critical value of the internal stiffness. A simplified formulation of the model with weak nonlinear terms yields an exact solution of its transition state. We further investigated the viscoelastic transition feature of the proposed structure to replace the cell-binding springs inside structure with damping components, and revealed the interesting transformation characteristics, which depend on the compressive load speeds. The main idea is that our abstract representation might provide an original perspective to nonlinear elastic phenomena in solid state matter.