Micromechanics of hierarchical materials: A brief overview

A short overview of micromechanical models of hierarchical materials (hybrid composites, biomaterials, fractal materials, etc.) is given. Several examples of the modeling of strength and damage in hierarchical materials are summarized, among them, 3D FE model of hybrid composites with nanoparticles, fiber bundle model of UD composites with hierarchically clustered fibers and 3D multilevel model of wood considered as a gradient, cellular material with layered composite cell walls. The main areas of research in micromechanics of hierarchical materials are identified, among them, the investigations of the effects of load redistribution between reinforcing elements at different scale levels, of the possibilities to control different material properties and to ensure synergy of strengthening effects at different scale levels and using the nanoreinforcement effects. The main future directions of the mechanics of hierarchical materials are listed, among them, the development of "concurrent" modeling techniques for hierarchical materials, optimal microstructure design at multiple scale levels using synergy effects, and the mechanical modeling of atomistic effects.

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