

Toughening mechanisms in multilayered materials

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Abstract:

Learning lessons from nature is the key element in the design of tough and light composites. Nacre shows the nature's ability to combine strong and brittle mineral with tough organic material into a multilayered composite. In this study, mechanical behavior and toughening mechanisms of nacre-inspired multilayered materials are explored computationally and experimentally. In nacre's structure tensile pillars, shear pillars and the roughness of the tablets play an important role in its overall mechanical performance. A micromechanics-based model for nacre is proposed to simulate the mechanical deformation and toughening mechanisms in the multilayered materials. Moreover, a 3D printing technique and a freeze casting method are used to create multilayered polymer/polymer and ceramic/polymer composites, respectively. The modeling results are compared with the experimental results for a range of multilayered materials.