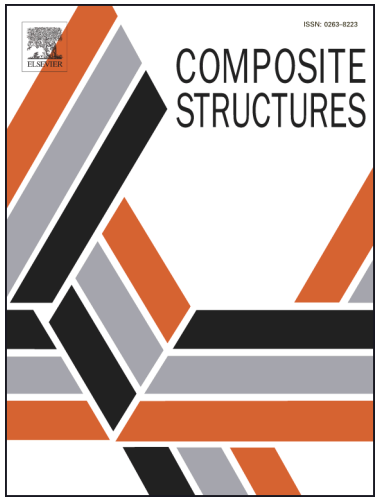

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Simulation of ballistic performance of a two-layered structure of nanostructured metal and ceramic

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ABSTRACT Two-layered structures, especially the metal/ceramic structure, have proved to have far better ballistic performance than a single-layered one. In this paper, a theoretical framework and numerical scheme, based on the combination of a mechanism-based strain gradient plasticity theory, micromechanics of composite model, the Johnson–Cook failure model, and the extended Drucker–Prager plasticity model, are set up to investigate a two-layered structure of nanostructured (NS) metal and ceramic. This study focuses on the different roles the two layers play during the protection process and clarifies the intrinsic significance of the ceramic layer and the metal layer according to different criteria of structural design. It is found that, in cases of targets with the same total thickness, the function of wearing and slowing down the projectile is mainly realized by the NS metal layer, while in cases of targets with a constant areal density, the function of wearing the projectile is mainly realized by the ceramic layer. Our simulations also show that, under the same impact velocity, the resistance of the target composed of the NS metal and ceramic laminates is remarkably stronger than that composed of coarse-grained metal and ceramic laminates.

Keywords: Ballistic performance; Nanostructured metal; Helmet; Wear degree; Deformation and resistance of target

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