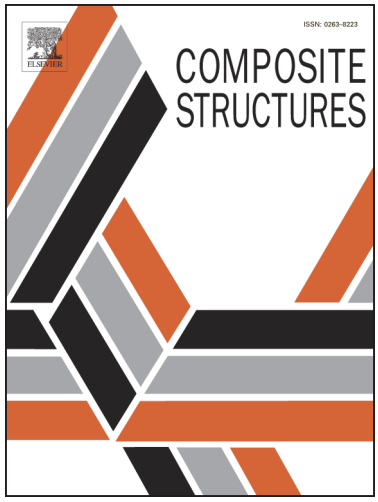

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A peridynamic model for dynamic fracture in functionally graded materials

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Abstract: We introduce a peridynamic model for functionally graded materials (FGMs) and study their dynamic fracture behavior. After verification of elastic wave propagation in FGMs and comparisons with analytical results for the classical model, we analyze dynamic fracture of a functionally graded plate with monotonically varying volume fraction of reinforcement. Mixed-mode loading is imparted by eccentric impact relative to a pre-crack. We study the influence of material gradients, elastic waves, and of contact time and magnitude of impact loading on the fracture behavior in terms of crack path geometry and crack propagation speed. The peridynamic simulations agree very well, through full failure, with experiments. The model leads to a better understanding of how cracks propagate in FGMs and of the factors that control crack path and its velocity in these materials. We discover an interesting effect that surface waves far from the crack tip have in "attracting" the crack towards their location. We discuss advantages offered by the peridynamic model in dynamic fracture of FGMs compared with, for example, FEM-based models.

Key words: Peridynamics, functionally graded materials, dynamic fracture, crack propagation, impact, brittle fracture.

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