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PROCEEDINGS

A Multiscale Model Predicting the Impact Performance of Fiber-Reinforced Composites

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ABSTRACT

Fiber-reinforced polymer composites with excellent impact energy absorption properties play a pivotal role in the safety of spacecraft, protection of military personnel and equipment, as well as high-speed transportation. Research on the impact performance of composite materials has always relied mainly on expensive experiments and large-scale simulations. In this talk, we will introduce the “dynamic shear-lag model” by extending the classical shear-lag model to the dynamic domain. The dynamic shear-lag model reveals the transfer characteristics of impact energy in the microstructure scale of composite materials, and establishes a quantitative relationship between the " composition-microstructure-performance" of composite materials under impact loading. The model constructs the energy dissipation ratio frequency spectrum function that describes the energy dissipation characteristics of composite materials at different frequencies, whose mathematical form is only related to the dimensionless frequency and dimensionless viscosity. Based on this, we derived a multiscale theoretical model for predicting the impact ballistic limit velocity (V50) of composite panels, explaining the dependence of the composite material's impact limit on the matrix mechanical properties observed in previous experiments.

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