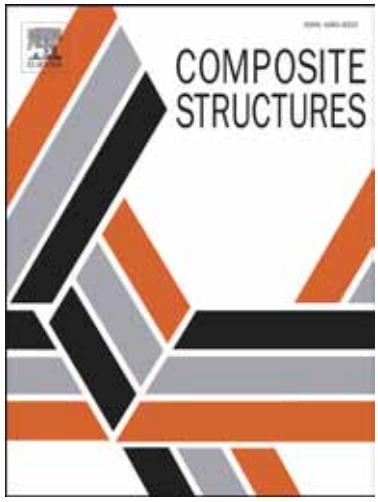

Characterizing the influence of matrix ductility on damage phenomenology in continuous fiber-reinforced thermoplastic laminates undergoing quasi-static indentation

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Characterizing the influence of matrix ductility on damage phenomenology in continuous fiber-reinforced thermoplastic laminates undergoing quasi-static indentation

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Abstract

The use of thermoplastic matrix was known to improve the impact properties of laminated composites. However, different ductility levels can exist in a single family of thermoplastic matrix, and this may consequently modify the damage phenomenology of thermoplastic composites. This paper focuses on the effect of matrix ductility on the out-of-plane properties of thermoplastic composites, which was studied through quasi-static indentation (QSI) test that may represent impact problem albeit the speed difference. We evaluated continuous glass-fiber reinforced polypropylene thermoplastic composites (GFPP), and selected homopolymer PP and copolymer PP that represent ductile and less ductile matrices, respectively. Several cross-ply laminates were selected to study the influence of ply thicknesses and relative orientation of interfaces on QSI properties of GFPP. It is expected that GFPP with ductile matrix improves energy absorption of GFPP. However, the damage mechanism is completely different between GFPP with ductile and GFPP with less ductile matrices. GFPP with ductile matrix exhibits smaller damage zone in comparison to the one with less ductile matrix. Higher matrix ductility inhibits the growth of ply cracking along the fiber, and this causes the limited size of delamination. The stacking sequence poses more influence on less ductile composites rather than the ductile one.

Keywords: A. Polymer-matrix composites (PMCs), A. Thermoplastic resin, B. Delamination, D. Mechanical testing