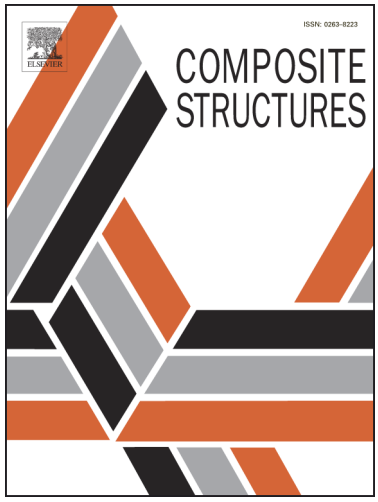

Surface topography induced high injection joining strength of polymer-metal composite and fracture mechanism

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Surface topography induced high injection joining strength of polymer-metal composite and fracture mechanism

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Abstract: A new injection joining technology based on surface topography was presented to form polymer-metal composite structure (PMCS) which plays a pivotal role in engineering field. A temperature control system facilitating filling of the surface structures by polymer melt was established. The quantitative relation between the surface topography and the interfacial mechanical strength was demonstrated, and the optimum dimension scope of the surface topography for achieving good mechanical performance of PMCS was determined. Using the optimum dimensions, the shearing strength between the metal and polymer interface reaches about eleven folds compared to the case with non-treated metal surfaces. The fracture mechanism of the PMCS was analyzed and disclosed. Meanwhile, for better understanding filling process of the structure by the melt, a numerical model was established to investigate effects of surface topography and the injection parameters on the melt flowing process. Experiment and simulation results can be used to guide the development of the new PMCS.

Keywords: Polymer-metal composite structure; Surface topography; Injection molding

1. Introduction

A large amount of energy consumption gradually brings serious global problems. Pursuing sustainable development has become one of the most important tasks of our society. Polymer-metal composite structures (PMCS) are supposed to be efficient energy saving parts, being lightweight and exhibiting high mechanical strength, as exemplified by their uses in numerous industrial components, ranging from large automotive parts to small electronic devices. A PMCS is a stamped piece of metal with internal plastic ribbing, which provides high stiffness and strength while significantly reducing the weight of the part. The common joining processes usually involve mechanical joining methods in which the plastic melt is put into the through-holes of metal to form plastic rivets for joining [1-4] and adhesive bonding methods where the metal and polymer are joined together through adhesive such as epoxy [5-7]. Although widely used in industry, such methods display some