"Twin Screw Extrusion Processing of Graded Composite Materials"

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Abstract

A novel method for fabricating graded composite materials has been developed using the technology of continuous processing with a Twin-Screw Extruder (TSE). While TSE processing has been investigated for controlling the fabrication of homogeneous composites in steady-state operating conditions, there is a lack of knowledge concerning the processing of gradient architectures using transient operating conditions. Therefore, there is a need to characterize and model the relationship between the extruder screw geometry, transient operating conditions, and the gradient architecture that evolves in the extruder. In this investigation, recent interpretations of the Residence Time Distributions (RTDs) and Residence Volume Distributions (RVDs) for polymer composites in the TSE are used to develop new process models for predicting compositional gradients in the direction of extrusion. An approach is developed for characterizing the sections of the extrudate using optical, mechanical, and compositional analysis to determine the gradient architectures for model verification. The new process models that have been developed in this research effort will serve as the basis for an inverse design procedure that is capable of determining optimal gradient architectures that conform to user-defined performance specifications in applications such as the processing of propellant grains for rocket motors.

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