DEVELOPMENT OF COMPOSITE VIA SECONDARY POLYMER-INDUCED PARTICLE AGGREGATION AND DESTRUCTION OF ITS PARTICLE AGGREGATION DURING 3D PRINTING

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ABSTRACT

The performance of polymer composite is determined depending on several parameters. Among them, particle dispersion and percolation structure control are the most important. In this study, poly(lactic acid) (PLA) composite was fabricated through a secondary polymer-induced particle aggregation. Particle dispersion was manipulated through the addition of secondary polymer with high-affinity to particles and analyzed corresponding changes in electrical conductivity and moduli. Through rheological scaling analysis of percolation structure, it was found that the addition of a small amount of secondary polymer induces diffusion of particle to form aggregates of high-order structure against interaction between particles. A ternary composite of PLA, poly(caprolactone) (PCL) and carbon black (CB) exhibited the PCL-induced CB aggregation when the amount of the PCL was comparable to that of particles. Particle percolation with a high-order structure improves the performance of composite like high storage modulus, high dielectric loss, and negative-positive switching of dielectric constant at high frequency (~ 100 Hz). Most of all, it induced a brittle-ductile transition to PLA. However, during 3D printing process of this ternary composite, CB aggregates were rearranged and percolation structure was disrupted under the given flow, resulting in a decrease in the modulus of the composite and lower electrical conductivity. Under high shear through nozzle, assemblies of CB aggregates could not remain close enough to maintain the percolation structure

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