BIO-BASED VITRIMERS FROM POLY(BUTYLENE SUCCINATE) VIA A TWO-STEP MELT VITRIMERIZATION PROCESS

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ABSTRACT

Vitrimers, pioneered by Leibler and co-workers in 2011, constitute a very new subcategory of dynamic crosslinked macromolecular structures (cited also as recyclable thermosets), that bridge the gap between thermosets and thermoplastics, as they combine ideally the processability and malleability of thermoplastics with the dimensional stability and robust mechanical properties of thermosets [1,2]. Their unique combination of properties derive from the topological rearrangement of the dynamic network by rapid *associative* exchange reactions upon heat or stress stimuli, while the number of the bonds and crosslink density remain constant. The current study proposed an efficient, solvent-free method to synthesize vitrimers using a model commercial biobased/biodegradable polyester, poly(butylene succinate), PBS. PBS was chosen since succinate polyesters are produced from biobased succinic acid and are considered promising alternatives to polyolefins [3]. More specifically, a two-step process was followed; the first step involved the preparation of the prepolymer by mixing PBS with the crosslinker (diglycidyl ether of bisphenol A, DGEBA or glycerol) and the transesterification catalyst (Zinc(II) acetylacetonate hydrate, $Zn(acac)_2$) in a twin-screw mini-compounder, in order to incorporate the reactants in the polymer mass. The second step (vitrimerization) comprised a crosslinking process of the homogenous mixtures in the melt state in a convection oven at 170 ˚C, resulting in the formation of a dynamic crosslinked network with epoxy or glycerol moieties serving as the crosslinkers. By tuning the crosslinker content (0 − 10% mol with respect to PBS repeating unit) and ratio of the Zinc(II) catalyst to crosslinker (0 to 1), tailor-made vitrimers were prepared with high insolubility and improved melt strength. Moreover, PBS vitrimers could still be reprocessed by compression molding after the crosslinking, which enables recycling process.

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KEYWORDS: poly(butylene succinate), epoxy-based vitrimers, polyesters, crosslinking, recycling

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