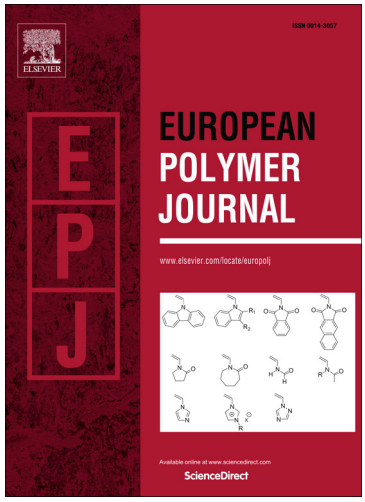

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Thermally reversible and biodegradable polyglycolic-acid-based networks

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Abstract:

The furan-maleimide Diels-Alder (DA) reaction was used to synthesize thermally reversible and biodegradable networks based on functionalized polyglycolic acid precursors. Hydroxyl-telechelic polyglycolic acid (PGA) with a well-controlled molar mass was first obtained by ring-opening polymerization (ROP) of glycolide catalyzed by $Sn(Oct)_2$ and using 1,4-butanediol as initiator. Functional furan polyglycolic acids with different functionalities were prepared by the isocyanate-alcohol condensation reaction from multi-alcohols such as glycerol and pentaerythritol, H_{12}MDI, PGA-diol and furfuryl alcohol. For a more effective control of the DA reaction conversion and before approaching the synthesis of the networks, a Diels-Alder adduct and a coupling agent bearing maleimide functions on its extremities were synthesized separately. At different stages, the obtained products were characterized by FTIR, NMR, DSC and SEC techniques. The thermoreversible networks were then obtained via two different methods: first, one in which the Diels-Alder adduct gives rise to the networks (method 1) and then via a one-shot process where the alcoholysis reaction of the coupling agent is responsible for the crosslinking (method 2). Thermomechanical analyses were used to verify the thermal reversible character of PGA-based networks. Furthermore, biodegradability studies such as in vitro degradation as well as aerobic biodegradability revealed that an increase in the polymer crosslinking density and a decrease in glycolide content typically lead to a slower degradation.

Keywords: Poly(glycolic acid); Diels-Alder; Thermo-reversibility; Rheology; Biodegradability.