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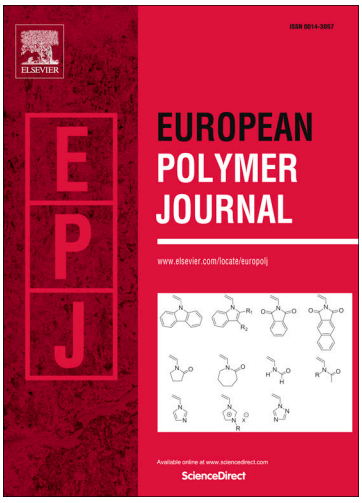

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High Performance Bio-based Thermosets from Dimethacrylated Epoxidized Sucrose Soyate (DMESS)

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Abstract

To tune the properties and reduce the viscosity of methacrylate functional epoxidized sucrose soyate (MESS), the use of a dual functionalization strategy was explored. Bio-based thermosets have previously been produced from free-radical curing of MESS having a large number of functional groups and have demonstrated a high glass transition temperature (T_g) and good mechanical properties. However, the MESS viscosity was high. To reduce the MESS viscosity, further functionalization of MESS was carried out by sequential addition of methacrylic anhydride. The synthesis was optimized and the resulting dimethacrylated epoxidized sucrose soyate (DMESS) was characterized using Fourier transform infrared spectroscopy (FTIR), proton nuclear magnetic resonance spectroscopy (^{1}H-NMR), gel permeation chromatography (GPC), and viscosity measurements. A series of DMESS with varying range of degrees of methacrylation was synthesized. The synthesized DMESS series were combined with varying amounts of styrene diluent and cured using a free radical process with peroxyesters as initiators. The extent of cure was determined by gel content using Soxhlet extraction and confirmed using FTIR. The thermal and mechanical properties were evaluated using thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), dynamic mechanical thermal analysis (DMTA), and tensile testing.

Keywords: Bio-based, thermosets, structure-property relationships

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