4-17-2024

Biobased Vitrimers via Melt-Polycondensation Process with Good Extensibility, Reprocessability, and Self-Healable Properties

Saiprasanna Neerukonda
Pittsburg State University

Biobased Elastomeric Vitrimer via Melt-Polycondensation with Good Extensibility, Reprocessability, and Self-Healable Properties

Sai Prasanna[1,2], Pranabesh Sahu[2], and Ram K. Gupta[1,2*]

[1]Department of Chemistry and [2]National Institute for Materials Advancement, Pittsburg State University
Pittsburg, KS 66762, USA

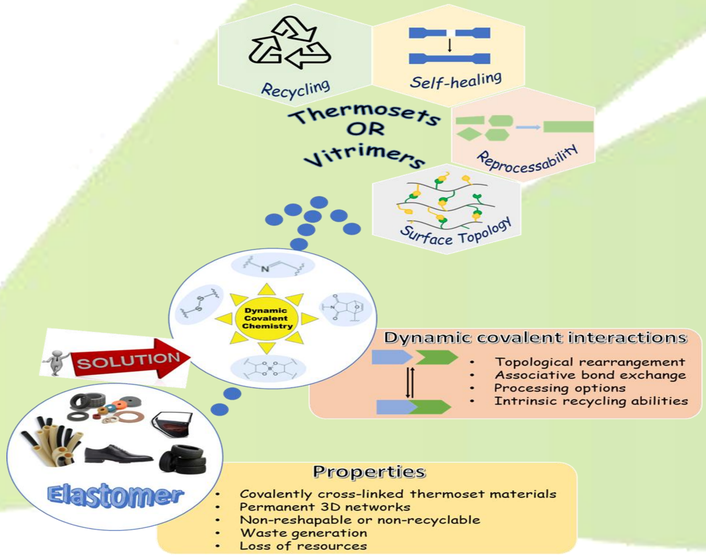
Abstract

The polymer industry's worldwide sustainable development is dependent upon the ease of synthesis and the replacement of Petro-based elastomers with biobased equivalents. Here, we suggest the condensation polymerization of aliphatic diacids and 1,4-butanediol with a catalytic amount of glycerol as curing agent and dithiodicarboxylic acid as the dynamic covalent crosslinker to fabricate highly stretchable elastomers. The elastomers showed good extensibility, reprocessability, and self-healable properties

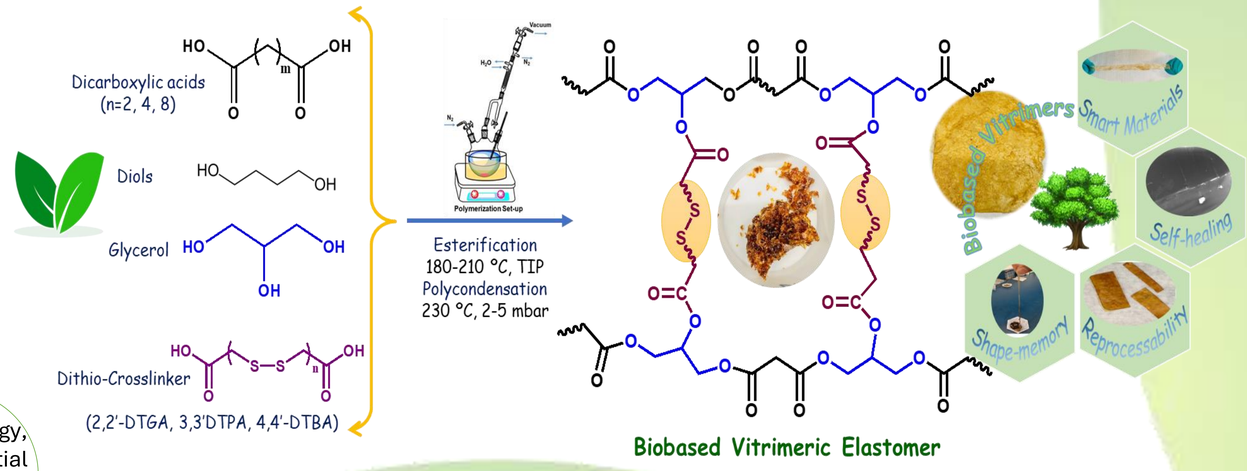
Introduction

The growing world population is fueling the demand for energy, chemicals, and materials on a global scale. Polymers are essential to modern life since they are utilized in everything from daily household items to clothing to automobiles, as well as in complex medical, diagnostic, and electronic applications. they inadvertently have some detrimental effects on the environment and climate change, consequences that the scientific community was not prepared for. Most of the monomers or chemical intermediates used today to fabricate polymers are based on crude fossil fuels such as coal and petroleum. Currently, the production of polymers uses almost 8% of all fossil oils. By 2050, this percentage is expected to rise to 20%. Therefore, there is a lot of interest in using natural biomass as raw materials to produce chemicals, polymers, and materials due to the growing concern about the unfavorable environment, continuous escalation in petroleum prices, and finite fossil fuel supplies

Properties

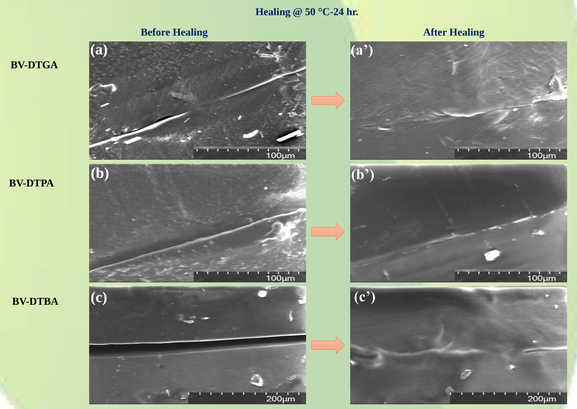


Synthesis



A series of biobased vitrimeric elastomers were synthesized following the conventional condensation polymerization of aliphatic dicarboxylic acids and 1,4-butanediol using glycerol and dithiocarboxylic acids with various chain lengths as the cross-linking monomer and dynamic networking material, respectively

Self-healing



Results and Discussion

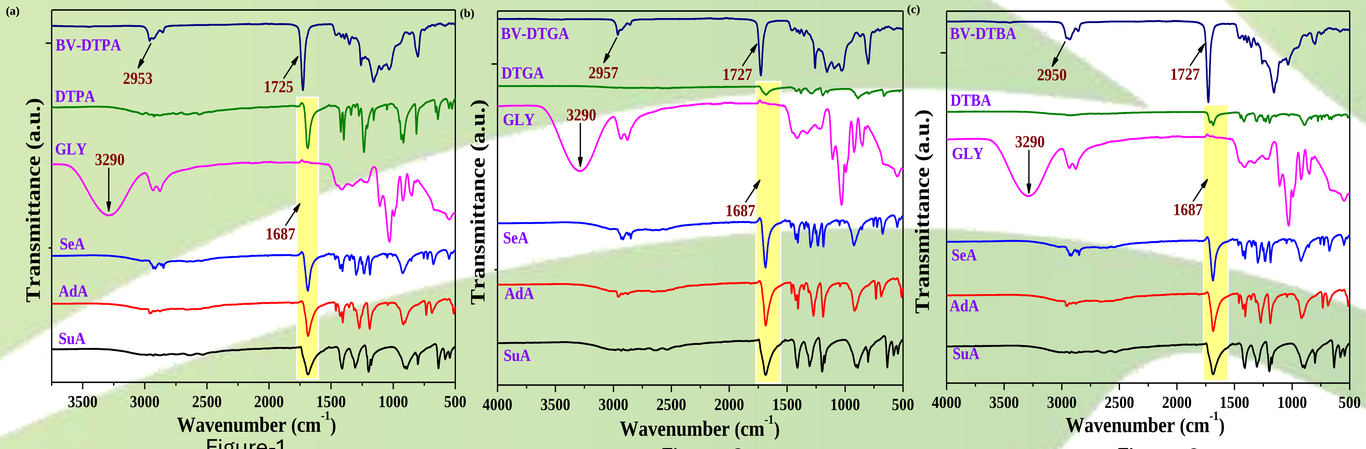


Figure-1 Figure-2 Figure-3

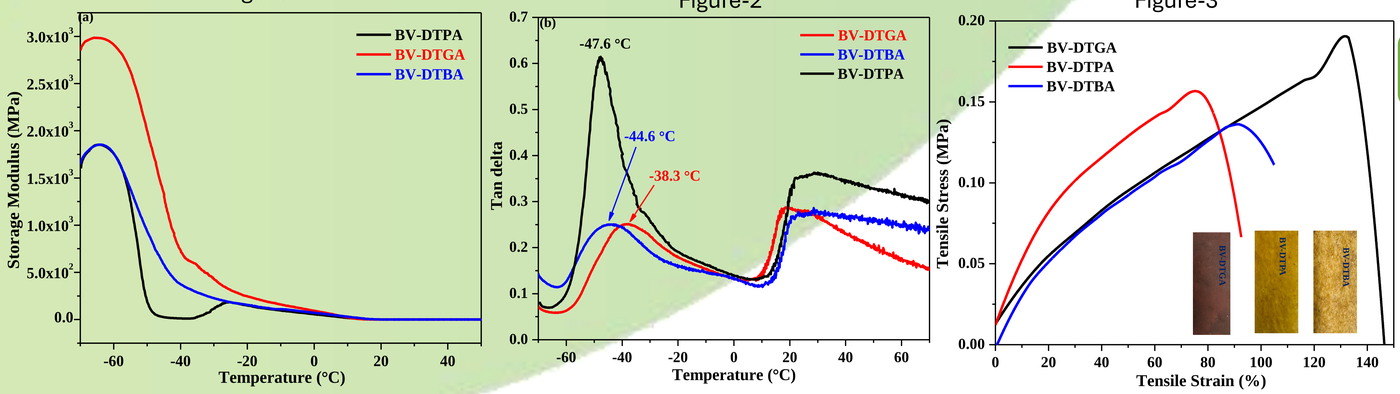


Figure-4 Figure-5 Figure-6

Conclusion

In this conclusion, the importance of developing mechanically resilient, flexible elastomeric materials that can be recyclable and reprocessable is illustrated. The concept of vitrimer chemistries in rubber materials by incorporating dynamic covalent bonds provides ways to impart materials ability to be healed and recycled, making them mechanically adaptable

Acknowledgement

➢National Institute for Materials Advancement
➢Pittsburg State University

References

http://dx.doi.org/10.1016/S0261-3069(00)00052-2

https://doi.org/10.1016/j.eurpolymj.2016.03.016