Reprocessable Thermosetting Epoxy Derived from Bio-Based Lignin Feedstock

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Abstract

Developing renewable bio-based thermosetting polymers that are repairable and recyclable will greatly advance the potential to satisfy sustainability demands. In this study, Kraft lignin, which is derived from wood, was used as a feedstock to prepare thermosetting polymers. First, Kraft lignin was chemically modified using an anhydride monomer to prepare our polycarboxylic acid (LPCA). This LPCA was then used as a curing agent to react with eugenol epoxy. We used the FT-IR, TGA, DSC, NMR, and optical microscope to determine the chemical, thermal, and self healing properties.

Advantages

- Fully Bio-Based
- Self Healing
- High Tg
- Reprocessability

Background

Commercial Product

Bio-Based Product

Synthesis route

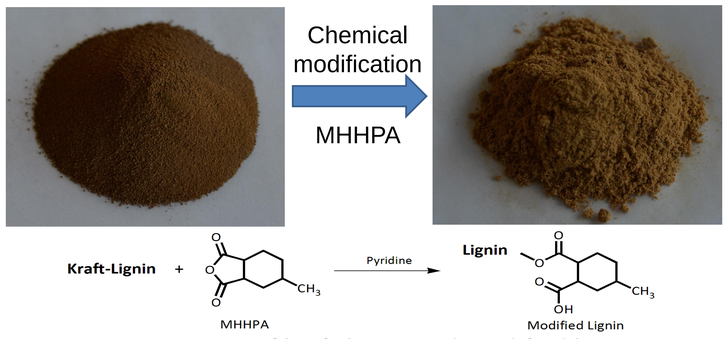
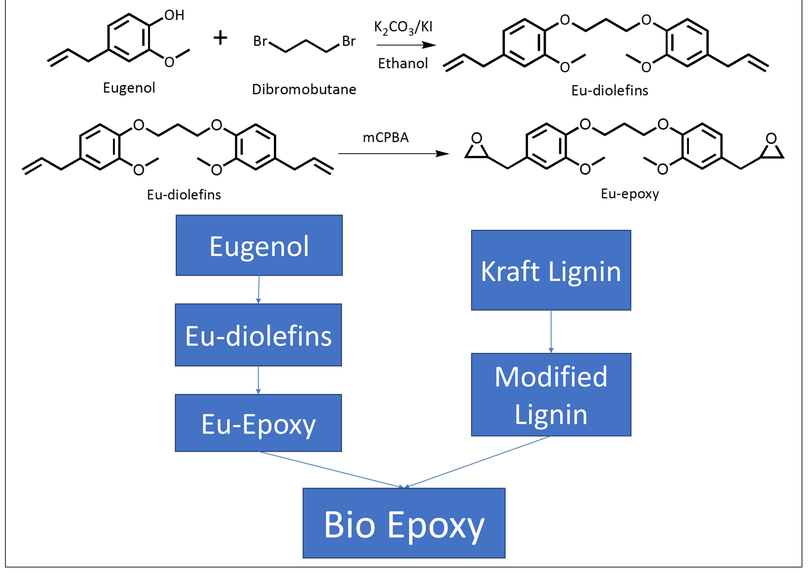


Fig. 1: Picture of kraft-lignin and modified lignin



Properties

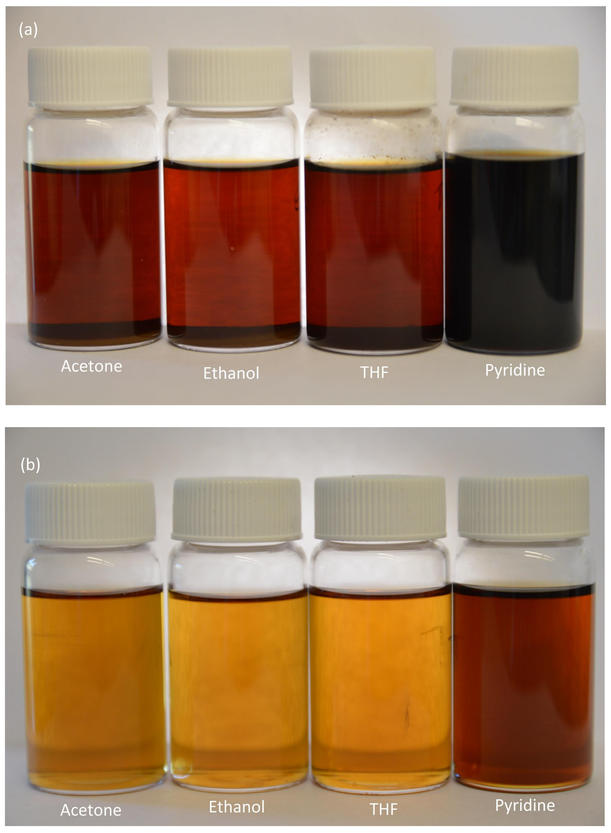


Fig. 2: Solubility test in different solvent of (a) Kraft-lignin and (b) modified lignin

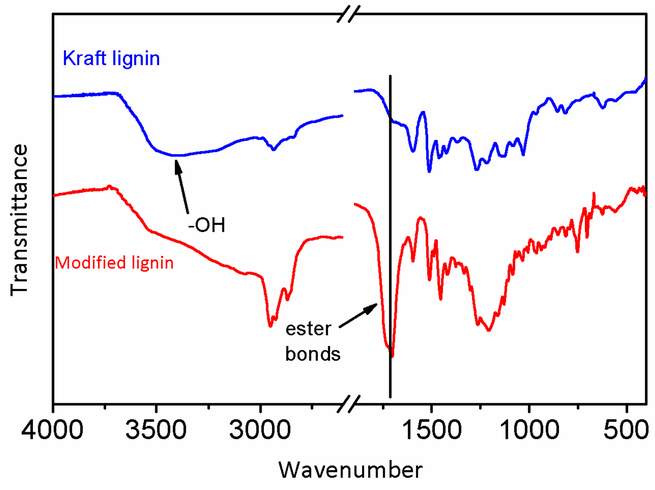


Fig. 3: FT-IR Test for Kraft-lignin and Modified Lignin

Epoxy Resin Properties

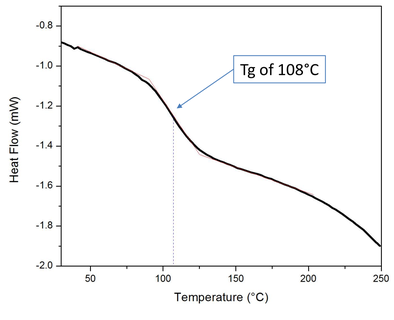


Fig. 4: DSC – Transition Glass Temperature for Cured Epoxy

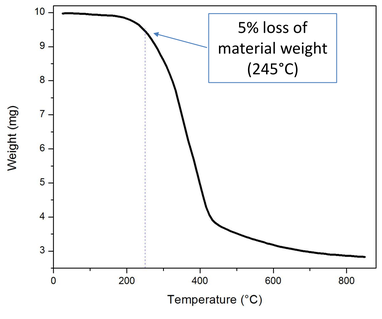
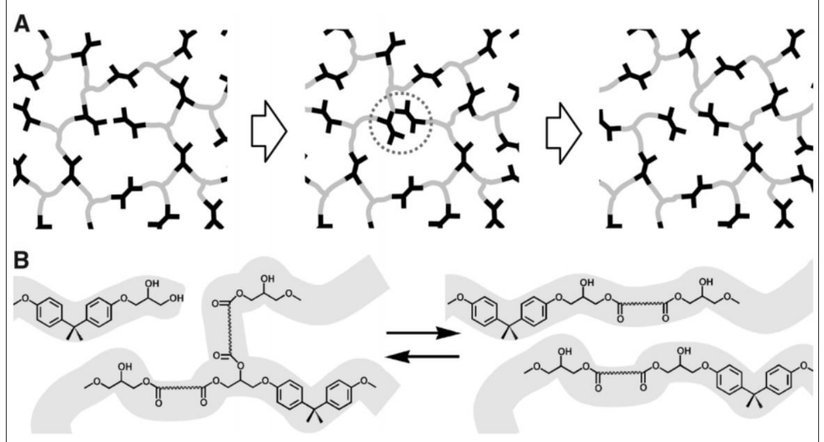


Fig. 5: TGA – Cured Epoxy

Transesterification



Epoxy Resin Properties

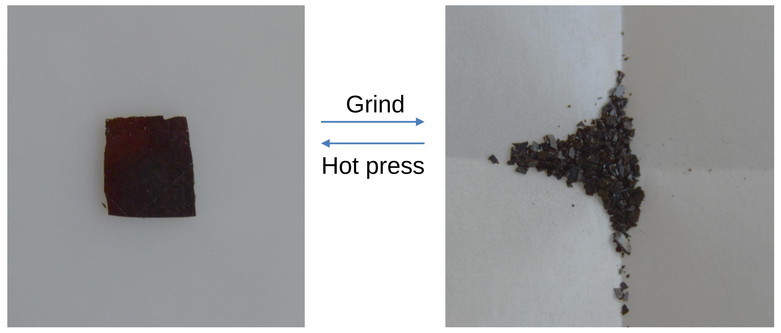


Fig. 6: Picture of Reprocessability of Cured Epoxy Resin

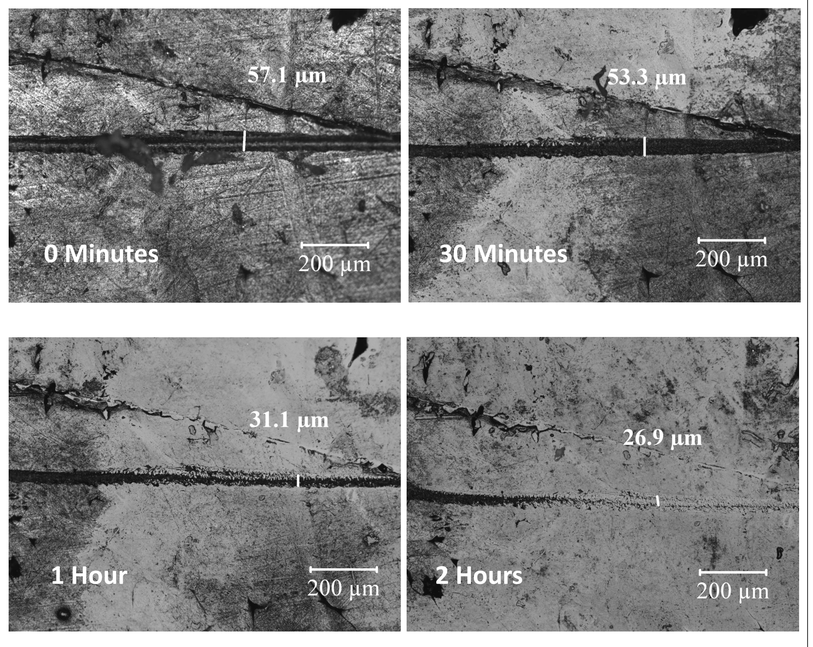


Fig. 7: Optical Microscope Image for Self Healing Properties with Increasing Time

Conclusion

- Developing method to obtain a bio-based epoxy resin derived from eugenol and lignin.
- Successfully characterized epoxy resin's properties showing high Tg, self healing, and reprocessability.

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