Lignin-derivable, sustainable, non-isocyanate polyurethanes: Films, nanofibers, and nanocomposites (NSF GCR CMMI 1934887; NSF DMR POL 2004682)

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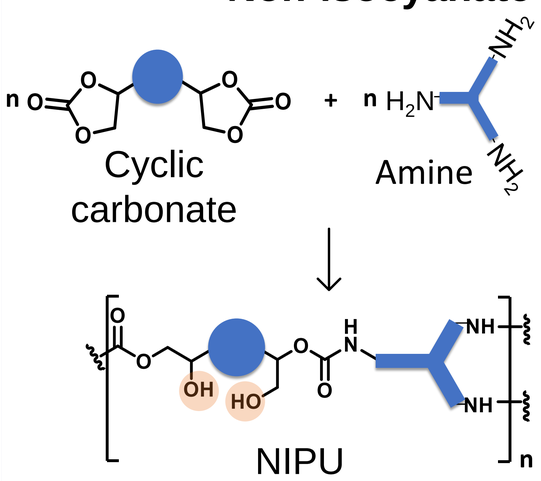
Goals

1. *Develop structure-activity relationships of lignin-derivable bisphenols to design potentially safer bisphenol A alternatives*
2. *Establish robust structure-property relationships in non-isocyanate polyurethanes (NIPUs) to guide next-generation materials design*

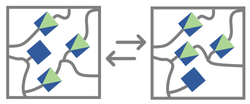
Brief overview

Non-isocyanate polyurethanes (NIPUs)

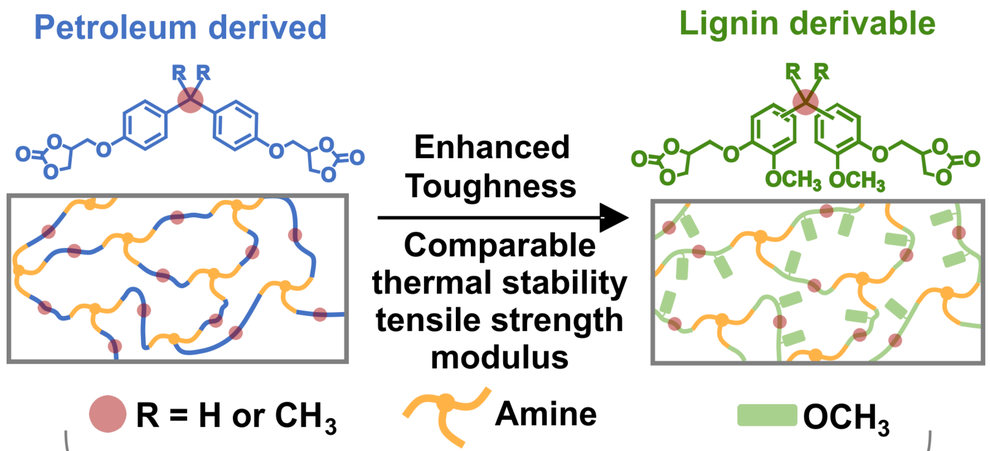


- ✓ Isocyanate free
- ✓ Utilizes CO_2
- ✓ Reactive sites
- ✓ Reprocessable thermosets[2]

Tunable properties for specific applications[1]



Thermoplastic and thermosetting NIPUs



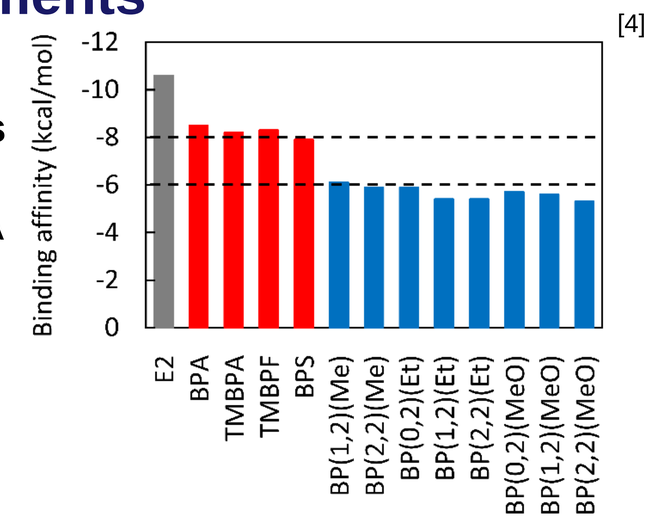
Handles to tune thermomechanical properties[3]

Important achievements

Potentially "safer", lignin-derivable bisphenols

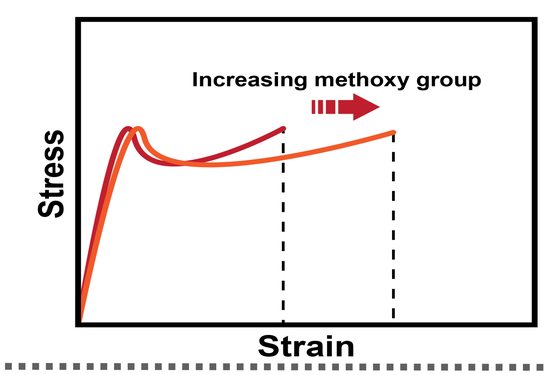
Reduced estrogenic activity,[4] genotoxicity, and oxidative DNA damage in comparison to commercial bisphenols[5]

(Collaborative work with other team members of NSF GCR CMMI 1934887)



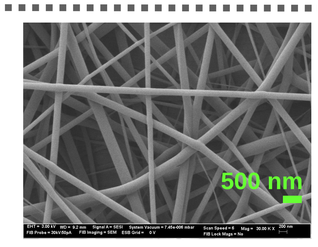
Enhanced "toughness" in lignin-derivable NIPUs

- ✓ Increase in methoxy content led to increase in toughness, strain-at-break
- ✓ Methoxy groups did not reduce thermal stability

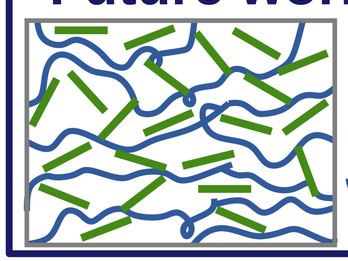


Next-generation, lignin-derivable nanofibers

Bisguaiacol A-based thermoplastic NIPU nanofiber fabrication *via* electrospinning



Future work/collaborative opportunities



NIPU-nanoclay composites

- Nanoclay
- Thermoplastic NIPU

Reprocessable & recyclable NIPU networks

References

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3. Mhatre et al., *Mater. Adv.*, 2022 (submitted).
4. Amitrano et al., *RSC Adv.*, 2021, 11, 22149-22158
5. Zhang et al., *Mutation Research - Genetic Toxicology and Environmental Mutagenes*, 2022 (submitted).

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- Korley Research Group https://sites.udel.edu/korleygroup/