Lignin-Derivable Diacrylate Networks: Exploring the Connection Between Network Architecture and Mechanics (NSF GCR CMMI 1934887)

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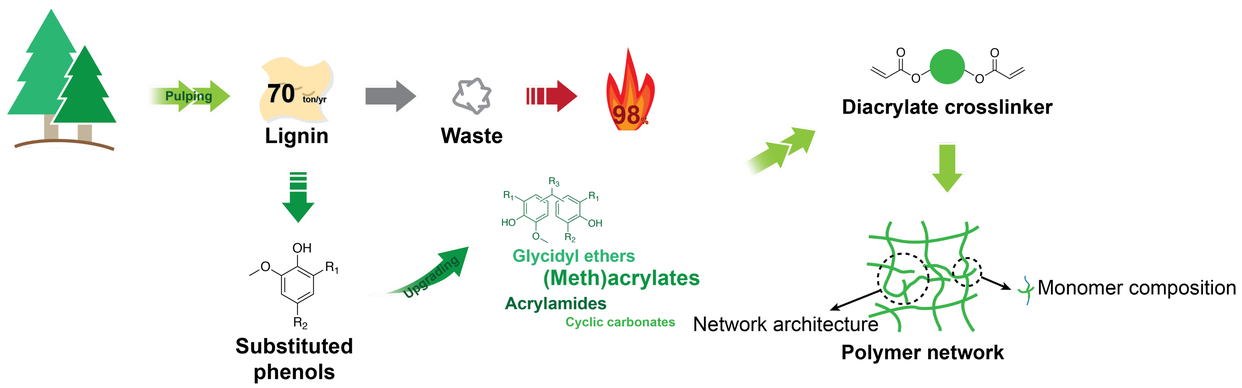
Goals

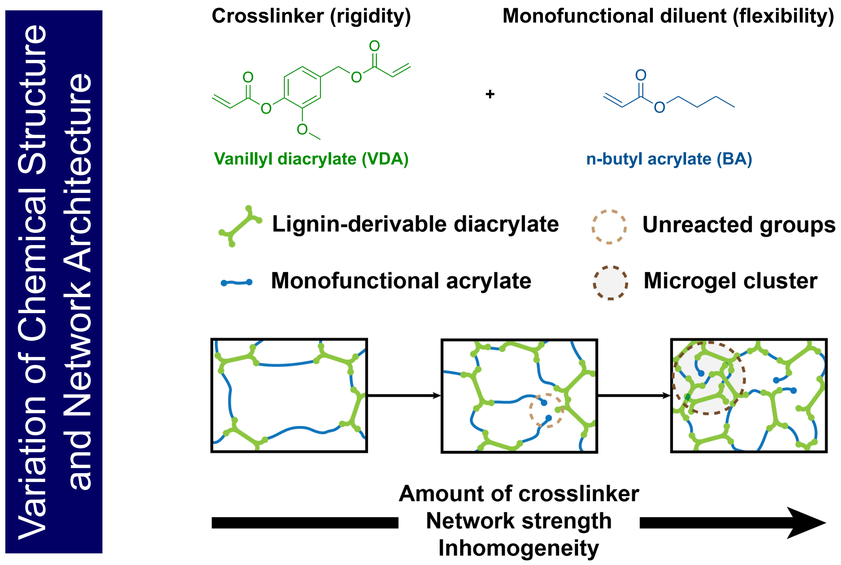
1. Develop structure-property relationships of lignin-derivable diacrylate networks
2. Investigate the effect of network architecture on material mechanics to guide the design of lignin-derivable high-performance (meth)acrylate materials

Overview



[1, 2, 3]

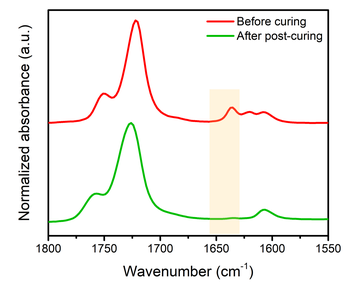
Variation of Chemical Structure and Network Architecture



Important Achievements

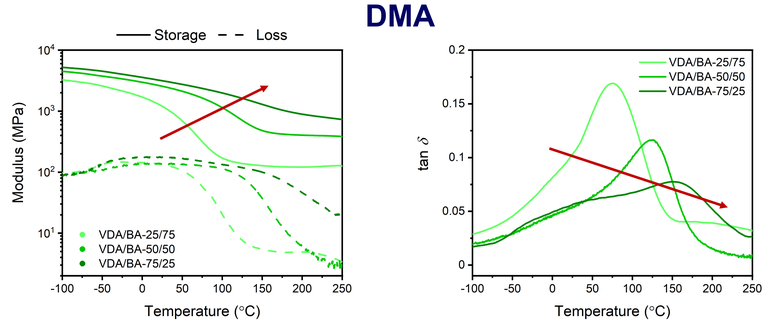
Ability to form free-standing films
- ✓ Highly transparent
- ✓ Rigid films that allow further characterizations and processing

ATR-FTIR



1630~1635 cm^{-1}: C=C stretch (acrylates)
1724 cm^{-1}: C=O stretch (reference)

DMA



	Final conversion (%)	$E_{25'}$ (GPa)	$E_{200'}$ (GPa)
25/75	92.4 ± 0.4	1.1 ± 0.4	0.13 ± 0.04
50/50	82.3 ± 7.4	2.6 ± 0.3	0.40 ± 0.05
75/25	61.6 ± 11.8	3.1 ± 0.2	0.89 ± 0.08

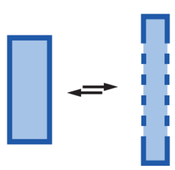
Tailored network architecture and thermomechanical properties
- ✓ Increased inhomogeneity (broader tan δ peak and lower conversion) with higher diacrylate content
- ✓ Enhanced storage modulus with higher diacrylate content

Future Work/ Collaborative Opportunities

Sustainable & Advanced functional materials

(Semi-)Interpenetrating networks

Shape memory materials



- Various chemistry (amine/imine, epoxy, *etc.*)
- Diverse functions (Energy dissipation, reprocessability, *etc.*)

References

[1] *ACS Sus. Chem. & Eng.* **2018**, *6*(11), 14812-14819
[2] *ACS Macro Letters* **2020**, *9*(4), 476-493
[3] *ACS Sus. Chem. & Eng.* **2020**, *8*(40), 15072-15096

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