Bio-Based Crosslinked Thermosets from Propiolated Castor Oil

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INTRODUCTION

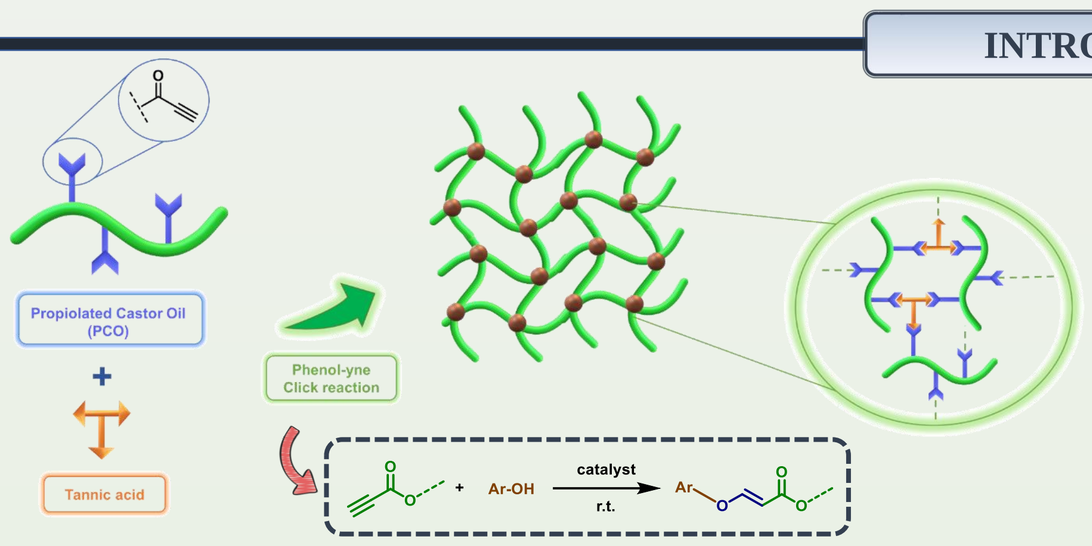

Figure 1: General scheme of thermoset formation via phenol-yne click reaction.

- Synthesis of flexible and environmentally sustainable thermoset polymers using tannic acid.
- Design of bio-based, thermoset systems with high crosslinking density for coating applications.
- Formation of rapid and efficient crosslinked networks via click reactions at room temperature.
- Environmentally benign crosslinking strategies were developed through energy-efficient click chemistry under mild conditions.

Aim of the study

EXPERIMENTAL PART

1

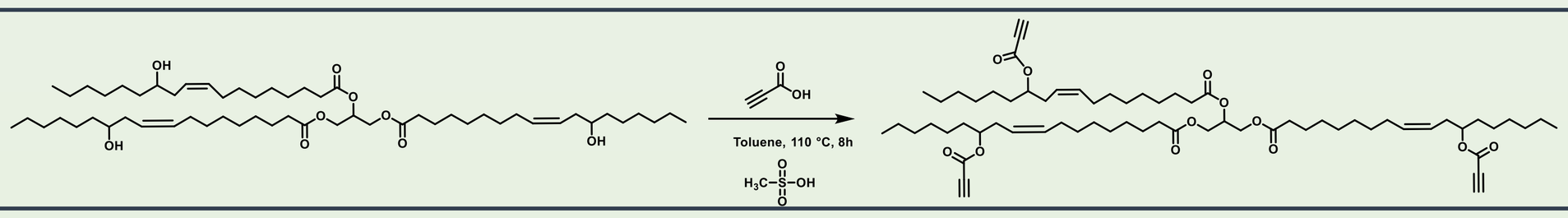

Figure 2: Synthesis of propiolated castor oil (PCO).

2

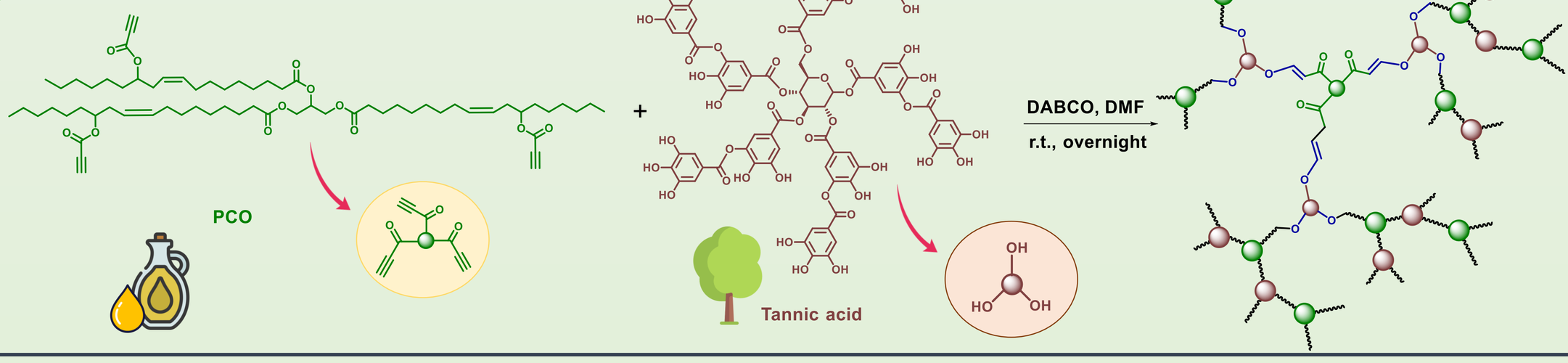

Figure 3: Synthesis of thermosets via phenol-yne click reaction.

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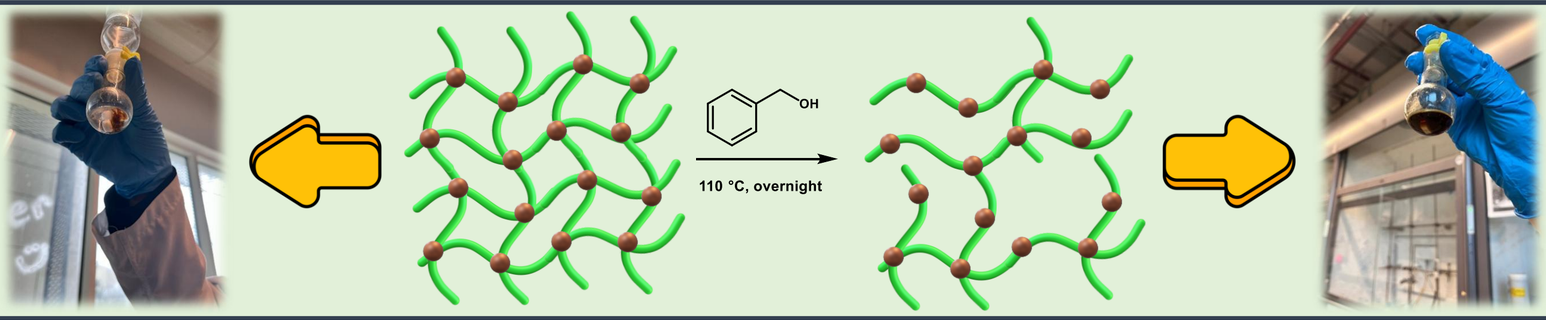

STRUCTURAL ANALYSIS

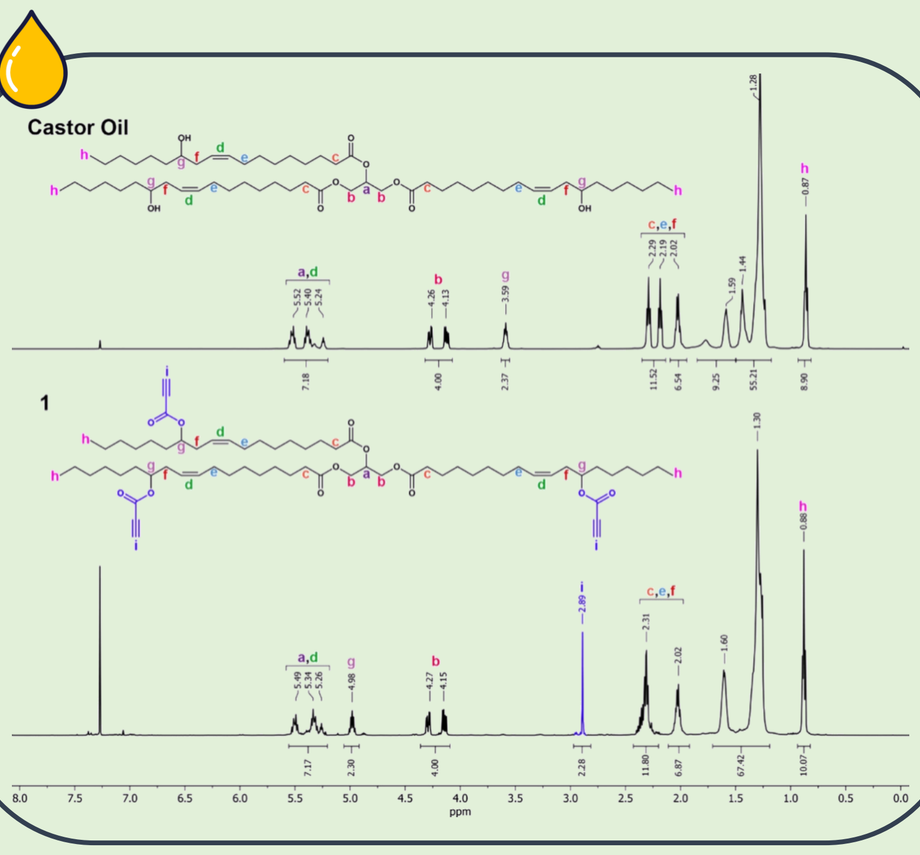

Figure 4: ^{1}H-NMR spectrum of PCO.

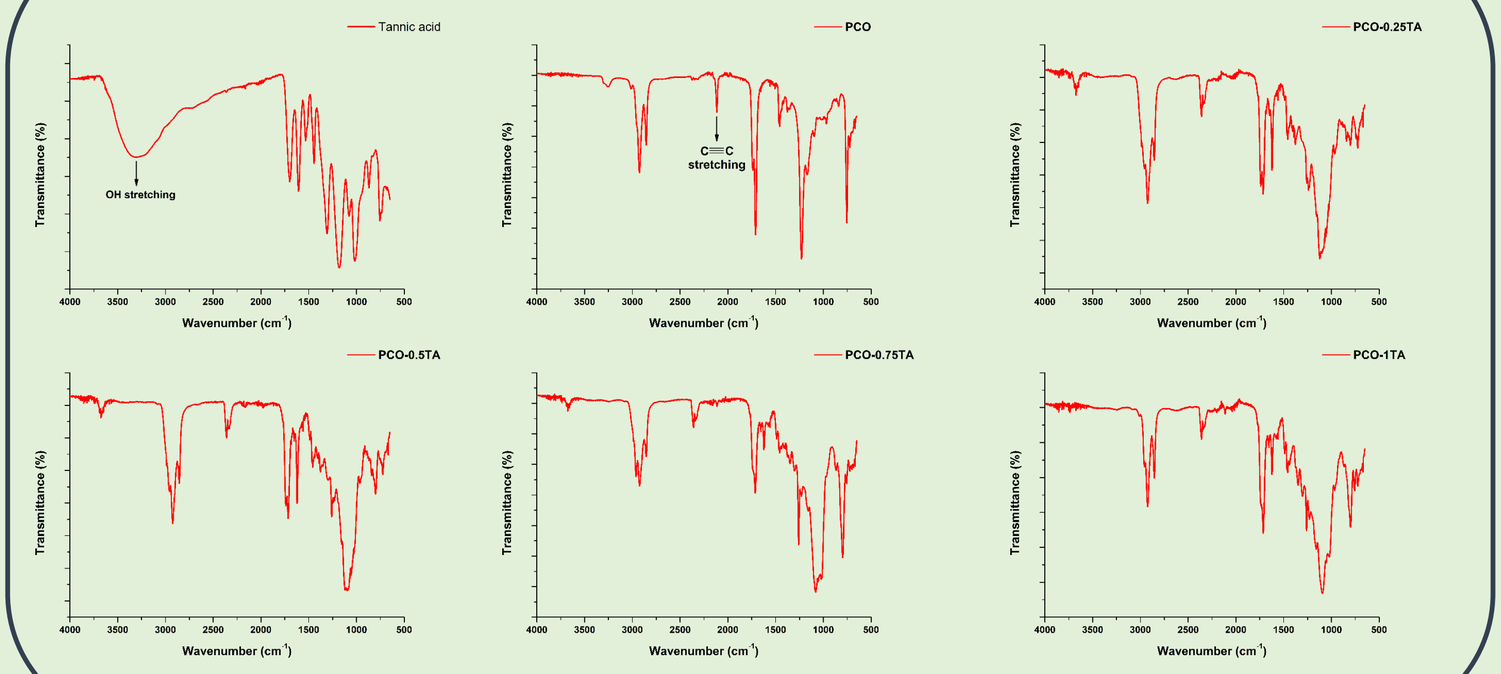

Figure 5: FTIR spectra of tannic acid. PCO and thermosets.

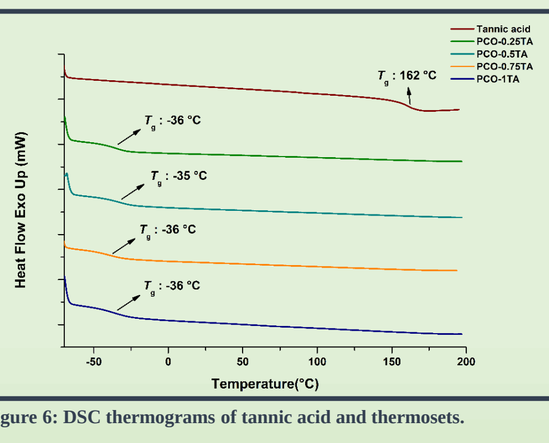

Figure 6: DSC thermograms of tannic acid and thermosets.

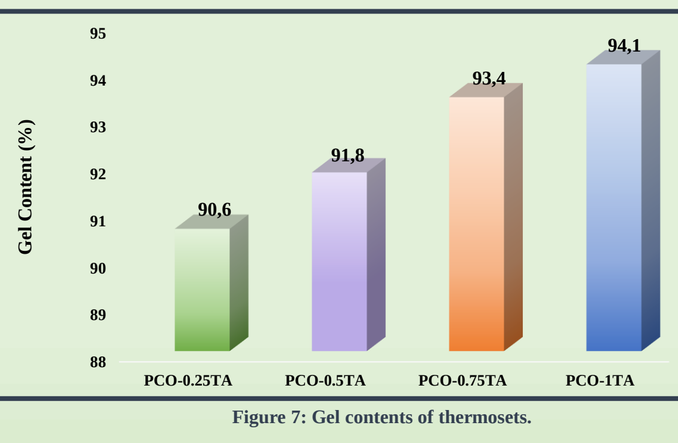

Figure 7: Gel contents of thermosets.

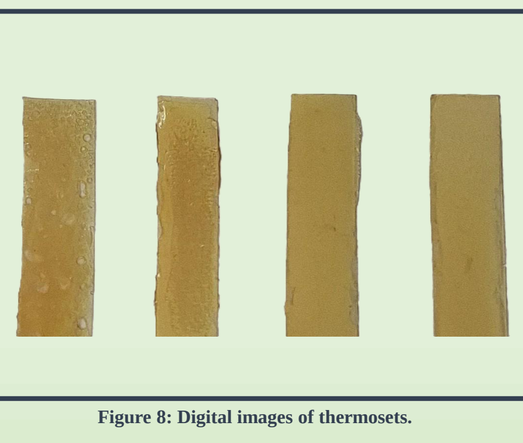

Figure 8: Digital images of thermosets.

CONCLUSIONS & OUTLOOK

In this study, a series of cross-linked thermosets were synthesized via the phenol-yne click reaction between propiolated castor oil-a bio-based platform previously developed by our group-and tannic acid, using DABCO as a catalyst at room temperature overnight. The resulting thermosets were characterized by Fourier-transform infrared spectroscopy (FTIR) and differential scanning calorimetry (DSC). Gel content was assessed through acetone extraction and was found to exceed 90%, indicating a high degree of cross-linking. Further analyses, including thermogravimetric analysis (TGA) and tensile (stress-strain) testing, are planned to evaluate the mechanical and thermal properties of the materials. These biobased thermosets show potential for application in sustainable coating systems.

References

- Celik, B., Kandemir, D., Luleburgaz, S., Cakmakci, E., Saim Gunay, U., Kumbaraci, V., & Durmaz, H. (2023). Propiolated castor oil: a novel and highly versatile bio-based platform for extremely fast, catalyst-, and solvent-free amino-yne click reactions. *ACS Sustainable Chemistry & Engineering*, *11*(2), 831-841.
- Sougrati, L., Duval, A., & Avérous, L. (2025). Introducing phenol-yne chemistry for the design of lignin-based vitrimers: towards sustainable and recyclable materials. Journal of Materials Chemistry A.
- Zhang, W., Gao, F., Shen, L., Chen, Y., & Lin, Y. (2022). Unexploited design and application of dynamic covalent networks: phenol-yne click reaction and porous film generation. ACS Materials Letters, 4(11), 2090-2096.