

Thermo-responsive NIPAM-Derived Copolymers for Selective Metal Ion Capture and Water Softening

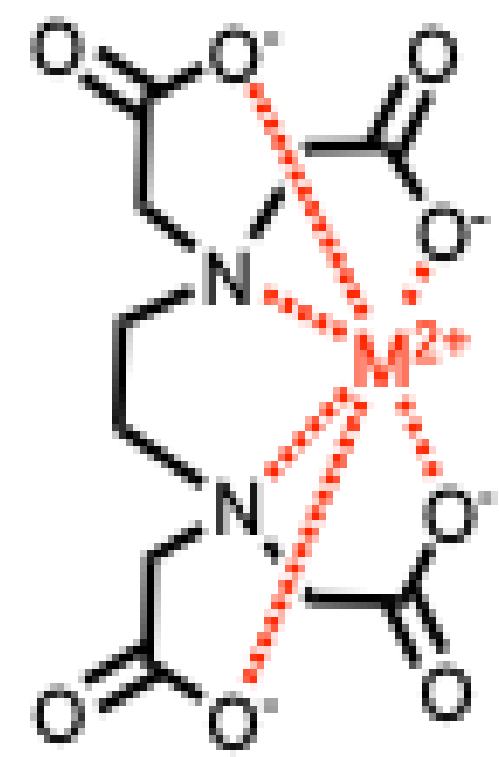
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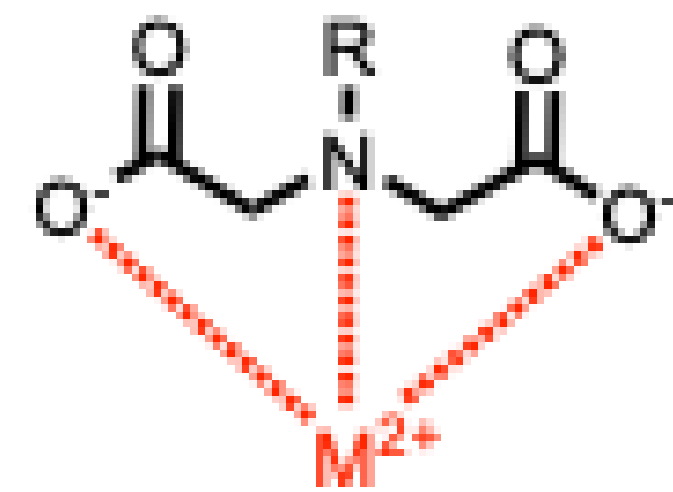
Overview/Motivations

Increasing concentrations of heavy metals and hardness ions present critical challenges to water quality, infrastructure, and public health. This while accelerating equipment degradation and reducing process efficiency.

This work develops thermo-responsive NIPAM-based copolymers for selective metal ion removal from water. Taking as precursor EDTA's metal ion configuration a NIPAM-GMA copolymer was functionalized with iminodiacetic acid (IDA), introducing carboxylate groups, strong metal-chelating groups. The polymer retains LCST (Lower Critical Solution Temperature) behavior, enabling temperature-controlled metal capture and recovery.



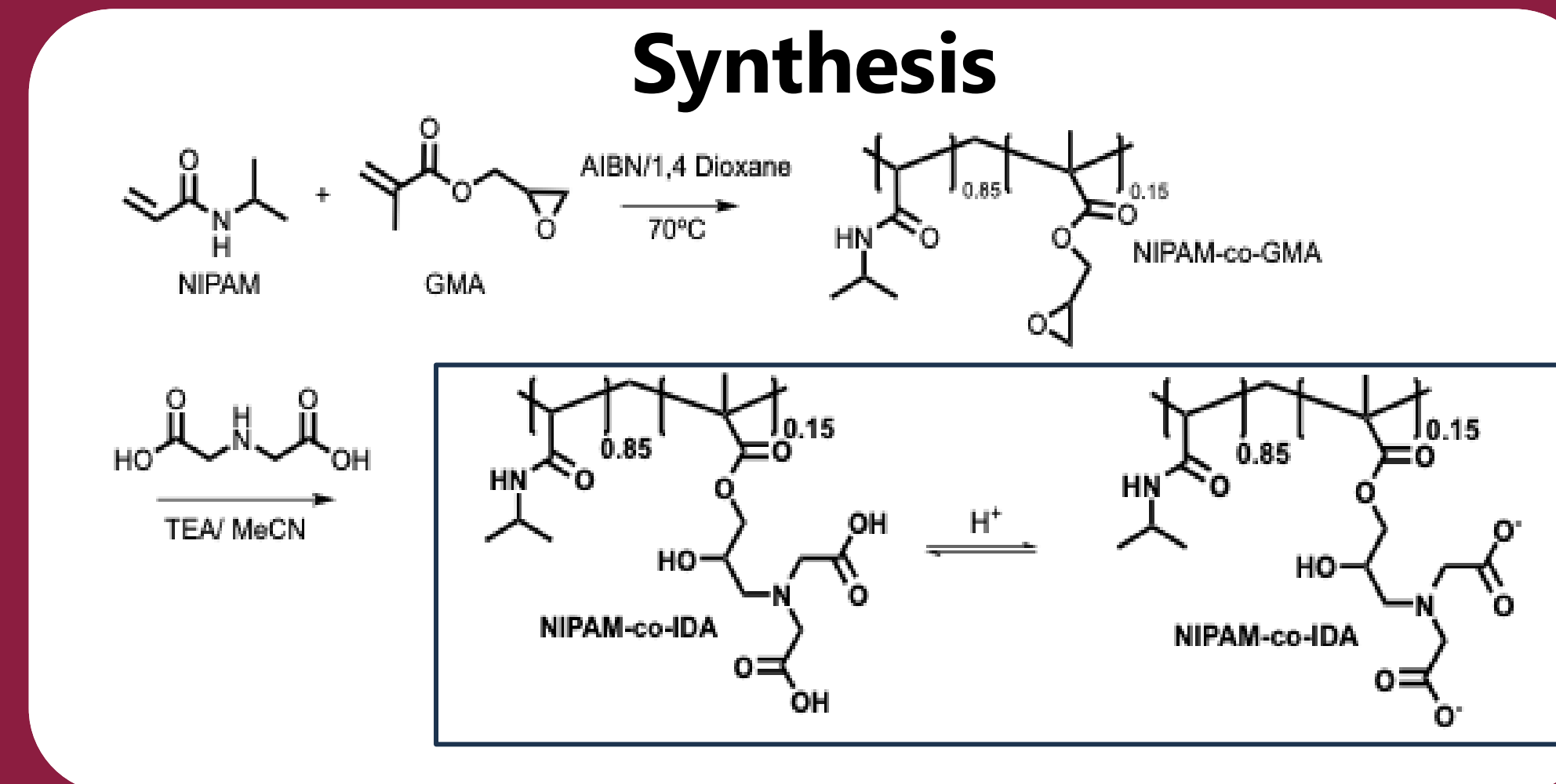
EDTA



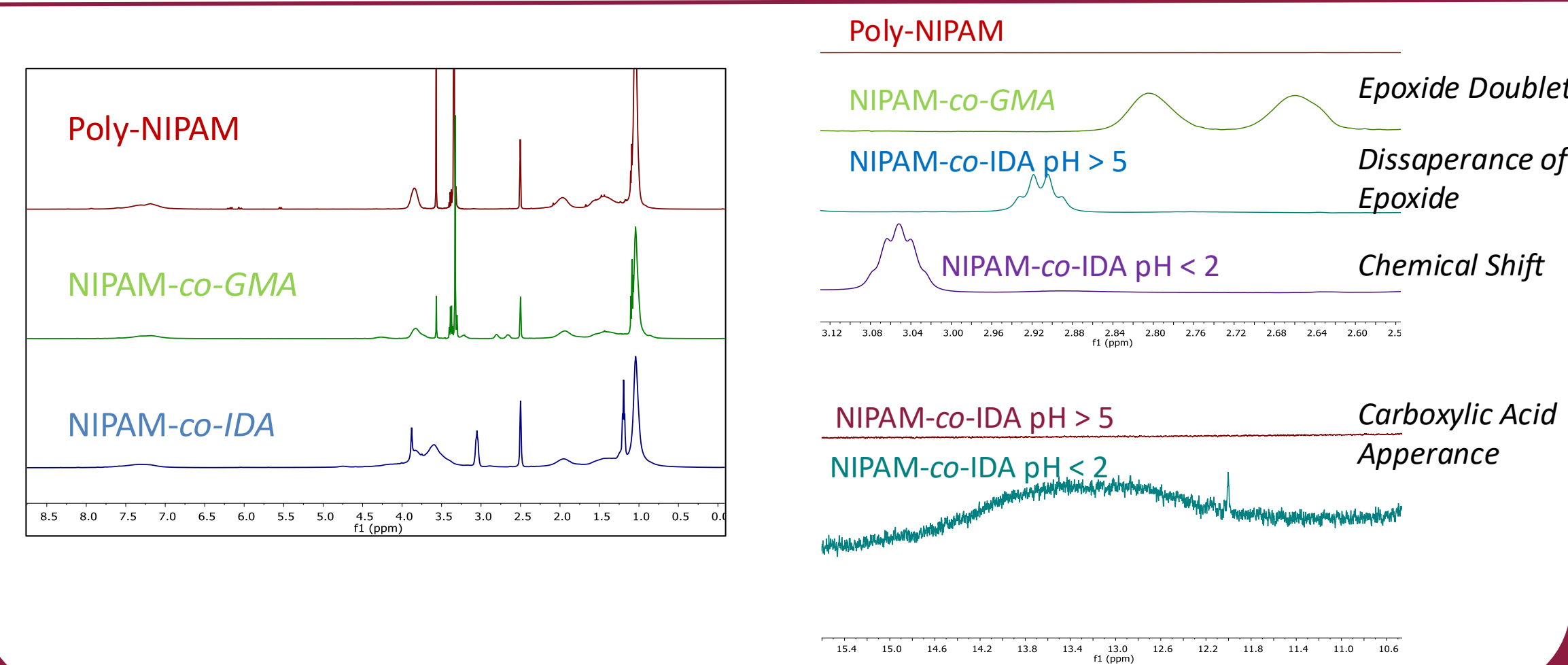
NIPAM-co-IDA

- Successful introduction of IDA chelating group in PNIPAM-co-IDA confirmed by 1H NMR and LCST behavior.
- The new thermo-responsive coordination copolymer shows pH differential response according to our predictions. (specific values)
- Coordination to Cu²⁺ decreases the LCST by 4°C, consistent with the Cu-IDA bond.
- TGA confirmed Thermal Stability.

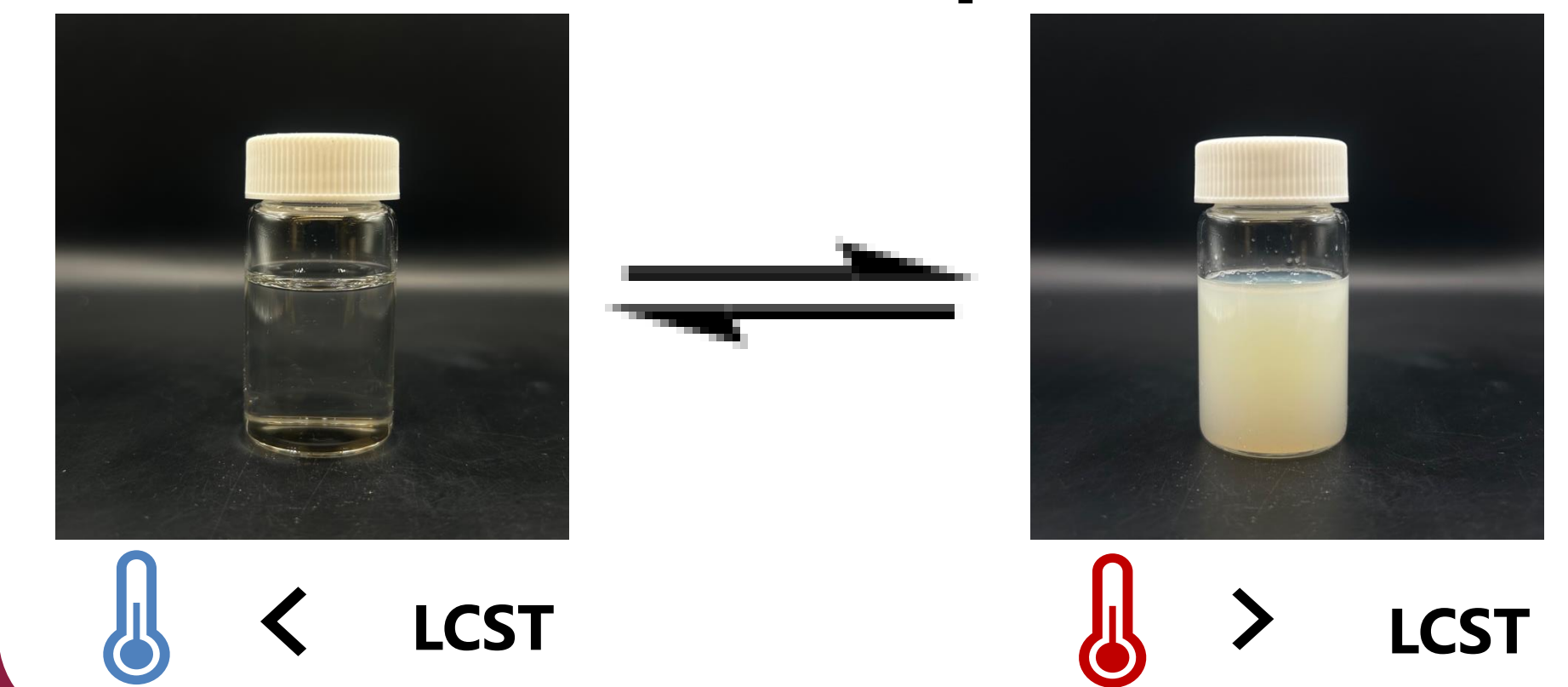
Conclusions



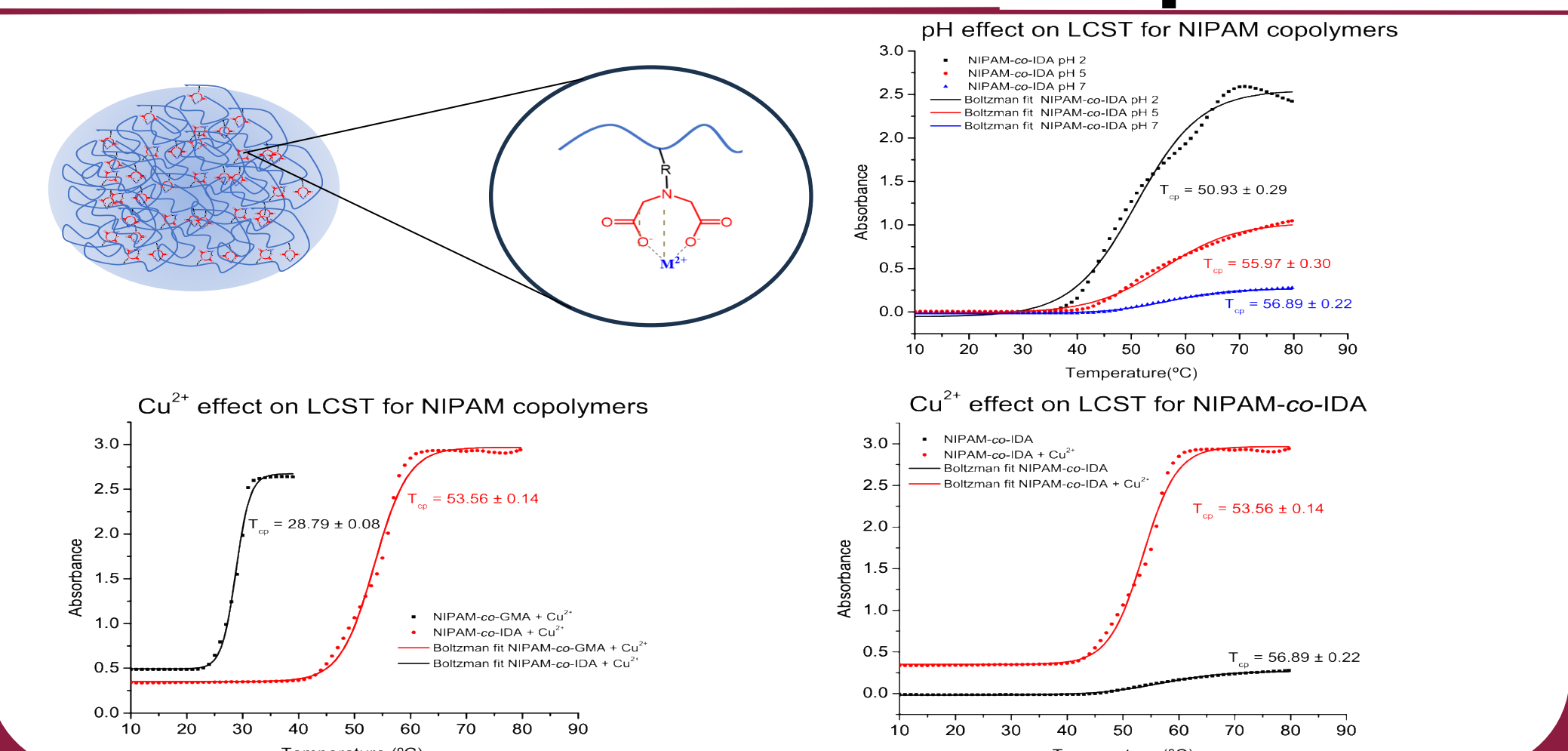
1H NMR



Thermal Response



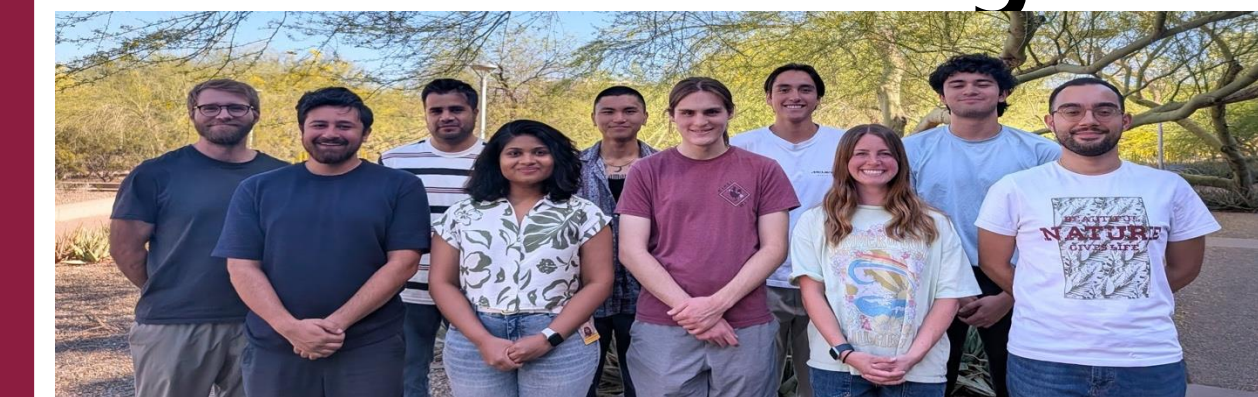
Lower Critical Solution Temperature



Future Work

- Perform and expand sequestration studies to other heavy metals.
- Investigate regeneration, recyclability, and thermal fatigue over multiple cycles.
- Test performance in simulated wastewater with competing ions.
- Tuning the LCST and solubility via the addition of hydrophilic/hydrophobic monomer ratios.
- Developing interface platforms for water treatment.

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