

Fabrication of Novel Self-healing Polymer based on Slide-ring Polyrotaxane Architecture of Polyurethane and Cyclodextrin

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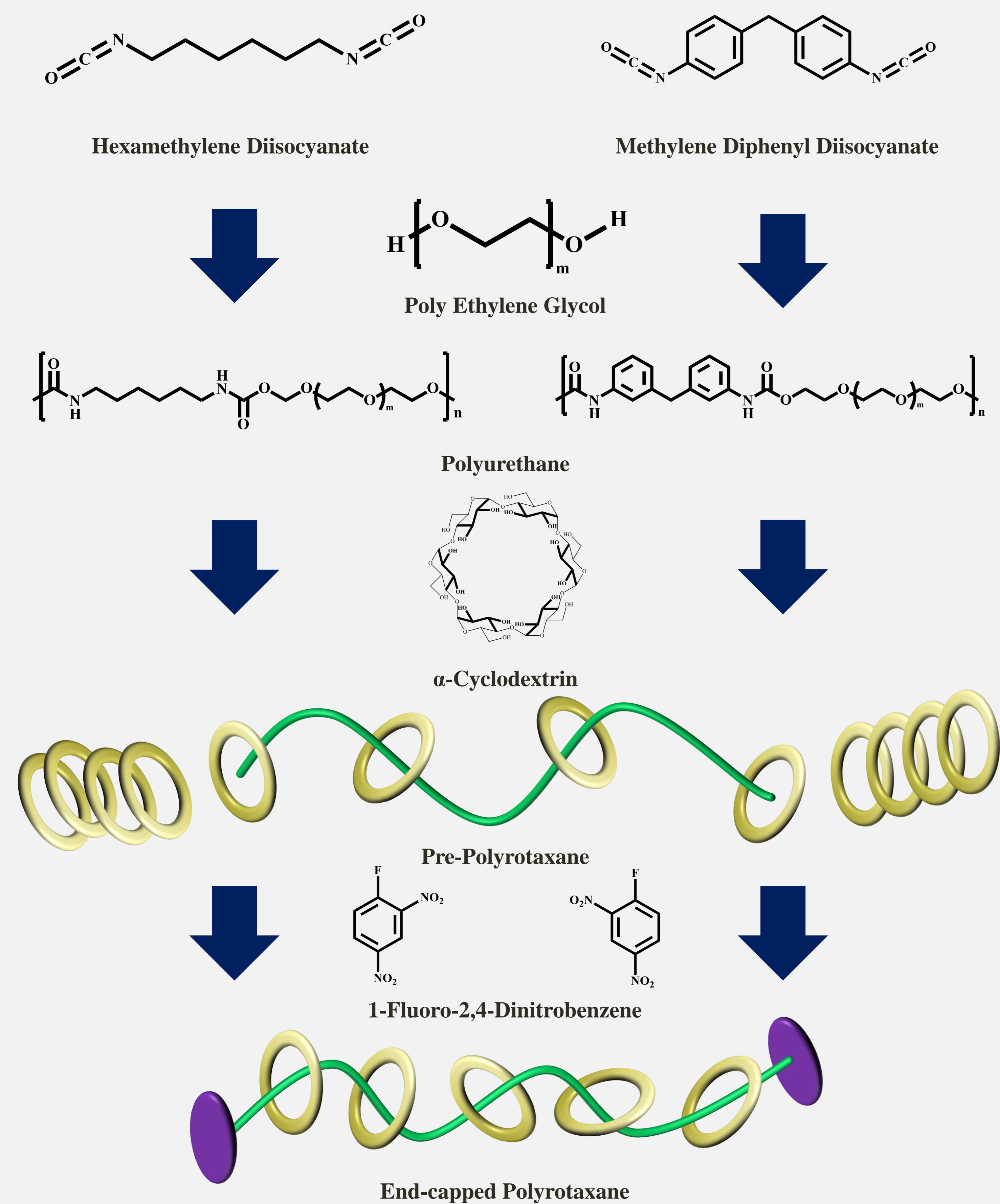
Abstract

Poly(Ethylene-glycol) (PEG)- α -cyclodextrin (α CD) polyrotaxane (PR) was fabricated by the polyrotaxane complex between PEG as long stick and α CD as circle ring in water solution. Self-healing polyurethane (PU) was prepared from PEG/ α CD PR and various isocyanate. 1-Fluoro-2,4-Dinitrobenzene was used as end-capping reagent. The fabrication and properties of PEG/ α CD PR-PU was analyzed by ^1H nuclear magnetic resonance (^1H -NMR), differential scanning calorimetry (DSC). Due to self-healing properties of the PR and the mechanical properties of the PU, it will be applied to abrasion resistance material coating.

Objective

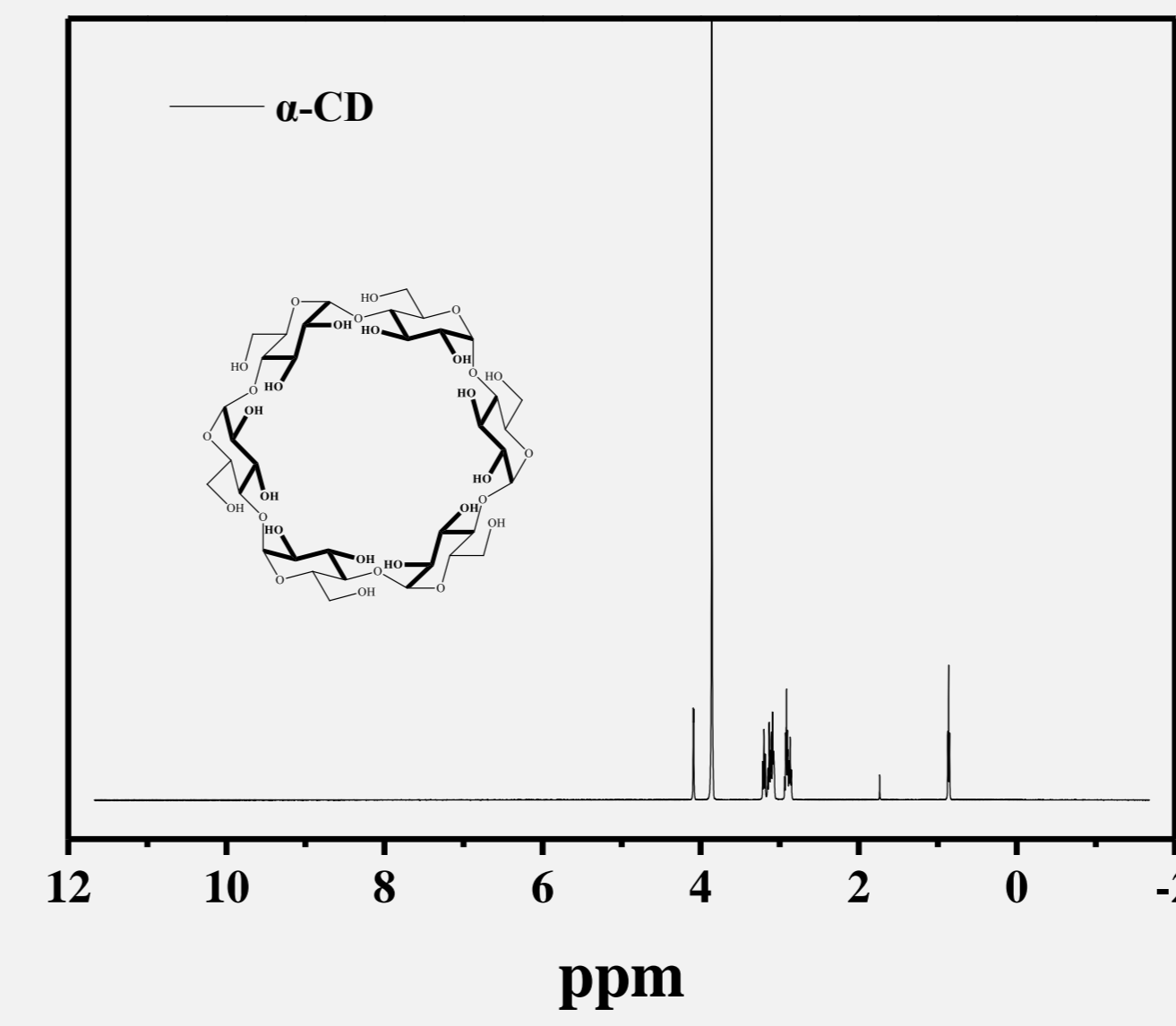
1. To synthesize a Polyrotaxane structure composed of PU as long stick and α CD as cyclic ring
2. To analyze the synthesis was successful and estimate thermal properties to find optimum self-healing temperature

Experimental

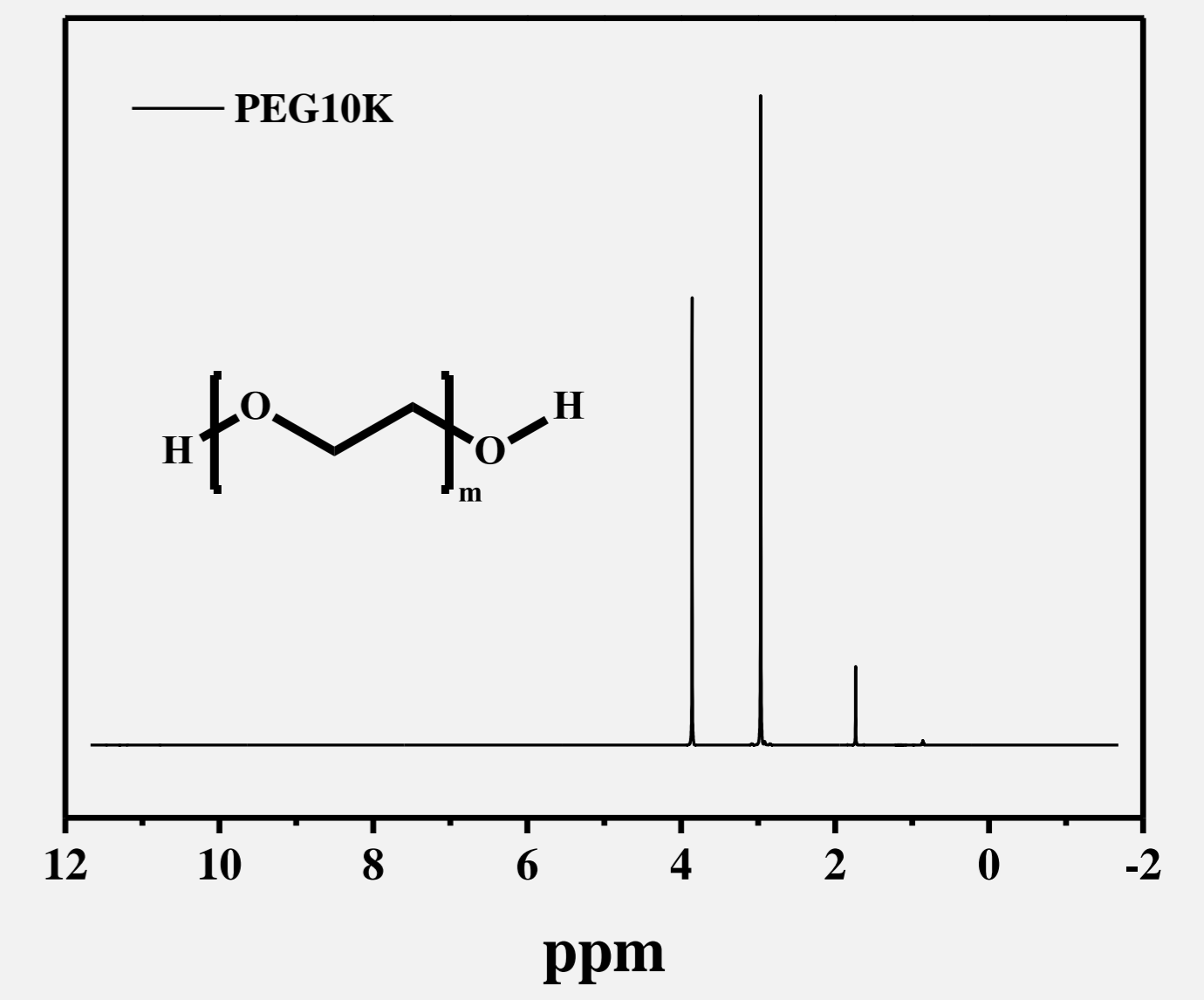


Results

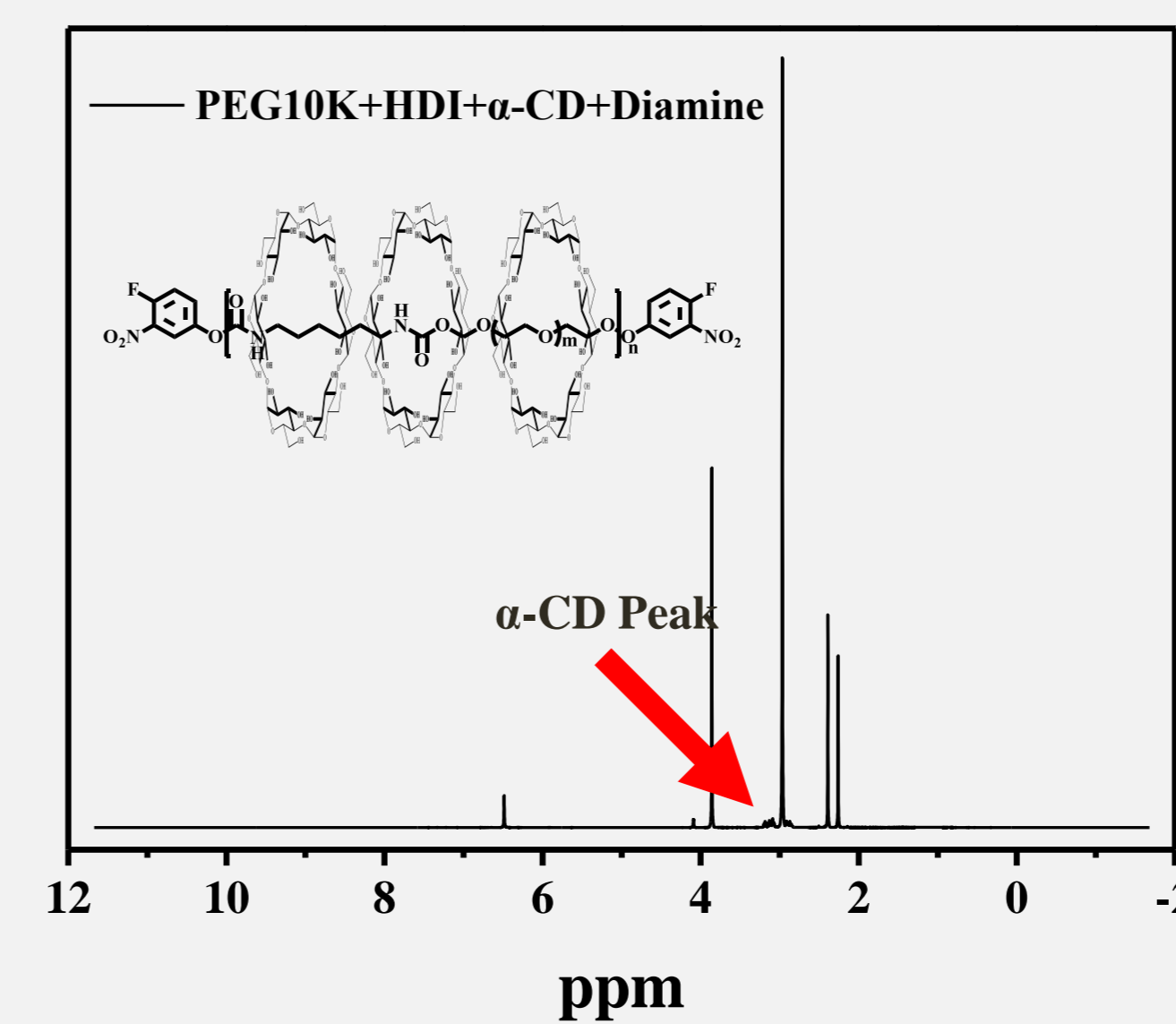
500MHz ^1H NMR



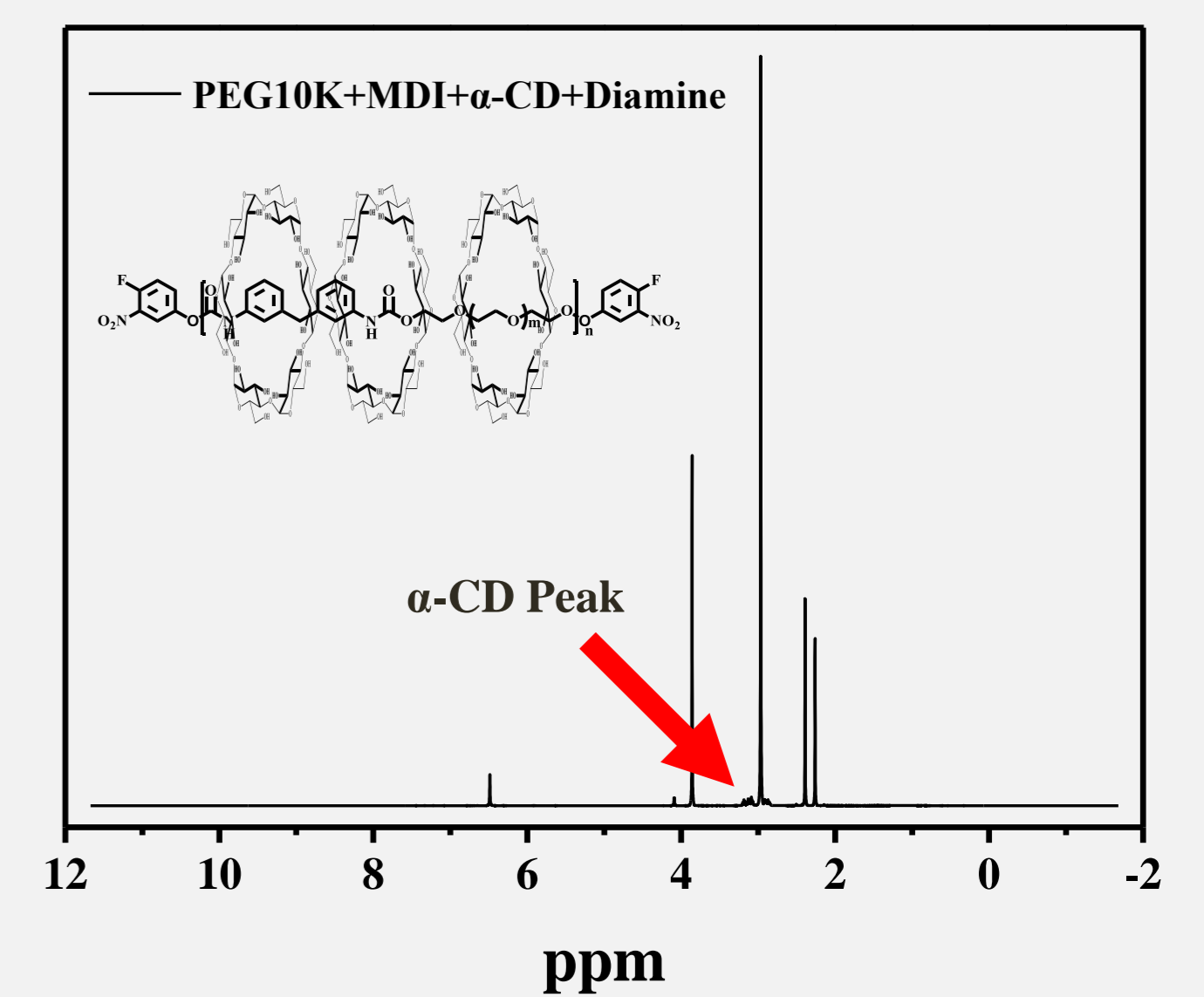
α -Cyclodextrin



Poly Ethylene Glycol (Mn = 10,000)

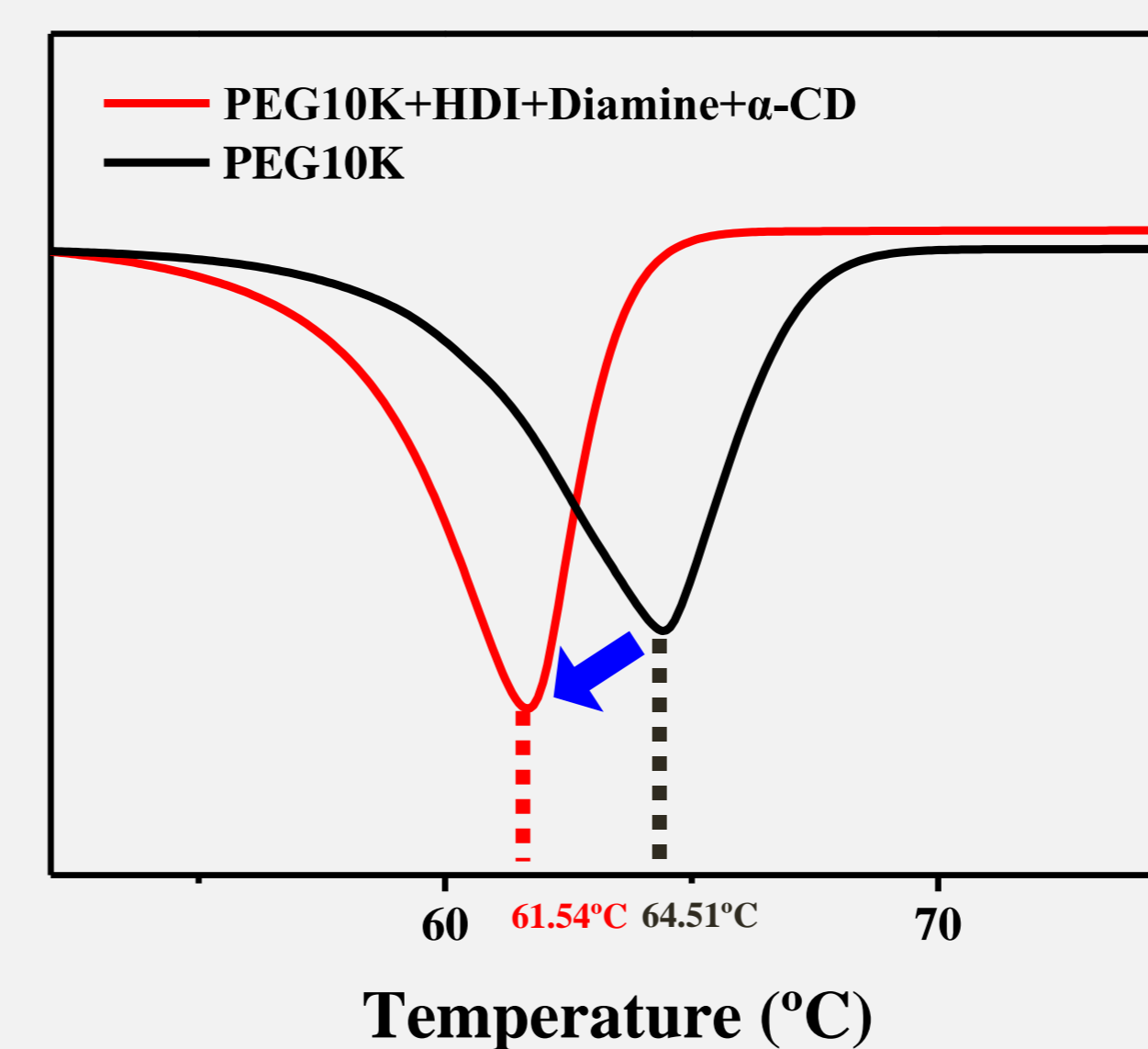


End-capped Polyrotaxane(PEG+HDI)



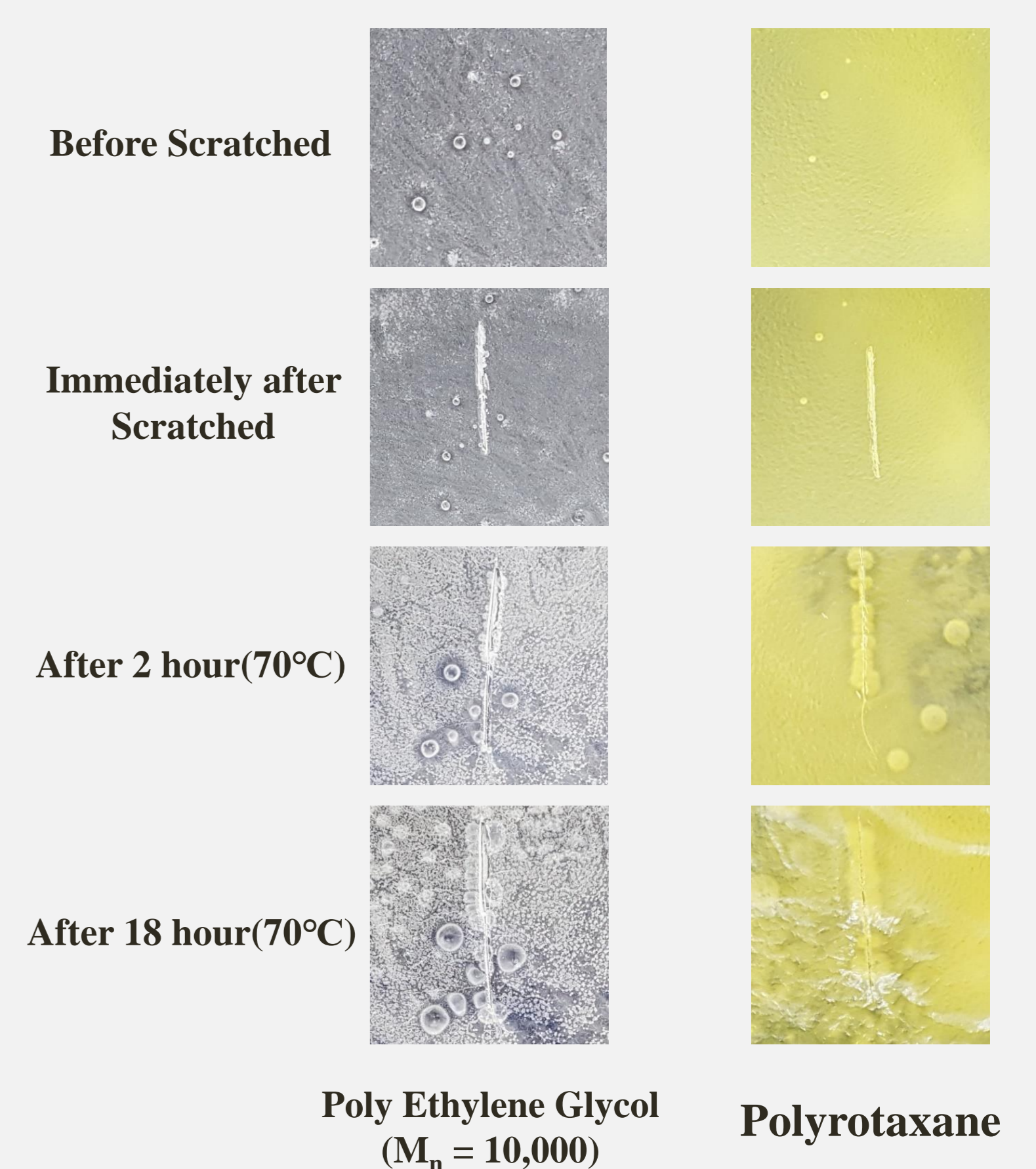
End-Capped Polyrotaxane(PEG+MDI)

DSC



Material	Melting Temperature ($^{\circ}\text{C}$)
PEG10K	64.507
PEG10K+HDI+Diamine+ α CD	61.539

Self-Healing Image



Conclusion

- Successful synthesis of PEG/ α CD PR-PU shown by ^1H NMR analysis
- Self healable of PR due to the lower melting temperature (T_m : 64.51 $^{\circ}\text{C}$ \rightarrow 61.54 $^{\circ}\text{C}$)
- To prove potential applications of abrasion resistance coatings

Acknowledgement

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