

Synthesis of Bio-based Cyclic Polycarbonate Based on Dynamic Covalent Chemistry and Its Applications

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Bio-based polymers are attracting attention as environmentally friendly materials. In particular, poly(isosorbide carbonate) (PIC) is expected to be the alternative to conventional petroleum polycarbonates as it has excellent recyclability toward fertilizer, high thermal stability, transparency, and so on.^[1,2] However, PIC by itself is inferior to general-purpose petroleum-derived polymers in terms of functionality, and their implementation in the real world has been limited.

In this study, we propose a method to functionalize PIC based on the dynamic behavior of the bis(2,2,6,6-tetramethylpiperidin-1-yl)disulfide (BiTEMPS) linkage. For controlling the primary structure of polymers, which is important for functionalizing polymers, cyclic compounds with the dynamic nature of BiTEMPS have been reported to be powerful precursors.^[3,4] Therefore, we synthesize cyclic PIC with BiTEMPS linkage utilizing the difference in solubility between end structures and polymers. The simplicity of the present procedure and purification is demonstrated by the highly efficient gram-scale synthesis of cyclic PIC; i.e., no catalysts, no additives, and no complicated synthesis procedures are required, because the radicals generated from BiTEMPS upon heating ($> 80\text{ }^{\circ}\text{C}$) are highly tolerant toward a variety of chemical species, including oxygen and olefins. In addition, dynamic cyclic PIC can be combined with other polymers or functional end groups through bond exchange reactions to impart the completely different properties of those polymers and/or to introduce functional groups at the polymer ends (Fig. 1).

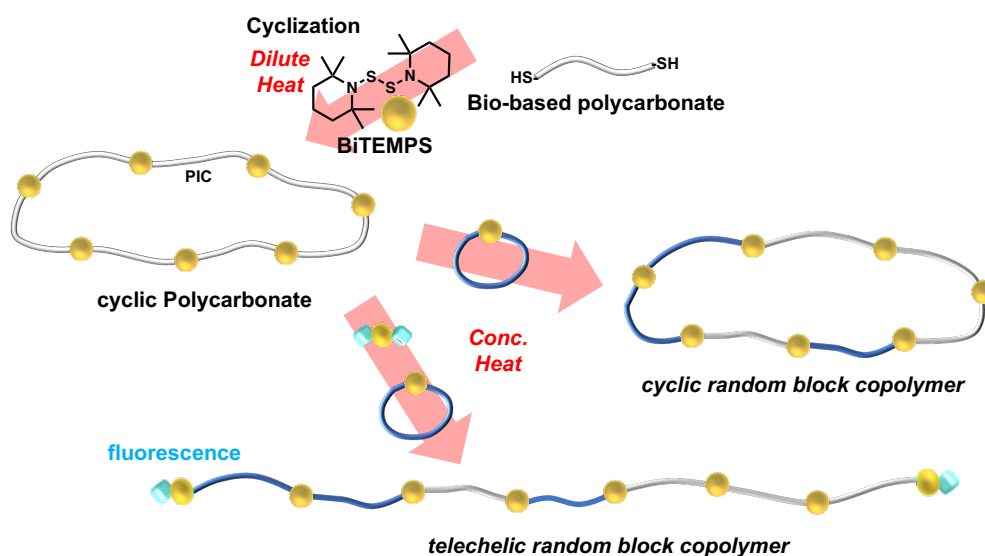


Fig. 1 Schematic image of synthesis bio-based cyclic polycarbonate using the dynamic behavior of BiTEMPS and functionalize cyclic polycarbonate through bond-exchange reaction.

References

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