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Dynamic Compatibilization of Polyolefin/Biopolymer Blends via Boronic Ester Exchange Chemistry

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The reliance of plastic production on non-renewable fossil resources has driven growing interest in bio-based alternatives, particularly the use of biopolymers as fillers. Derived from renewable sources, biopolymers offer environmental benefits like a reduced carbon footprint and improved material circularity. However, their integration into conventional thermoplastics, especially non-polar polyolefin, presents challenges due to limited interfacial compatibility. This often results in poor mechanical performance of the resulting composites. Biopolymers contain numerous diols that can undergo condensation reactions with boronic acids. In this study, we aim to incorporate biopolymers into polyolefin vitrimers to improve their sustainability and enhance their mechanical performance. We first examined the reactivity of diol groups present in different biopolymers. Based on these findings, we developed a compatibilization strategy using dynamic boronic ester exchange chemistry. This approach relies on reversible bonds formed between the diol groups and a functionalized thermoplastic, which could strengthen the interface while maintaining the material's ability to be reprocessed.

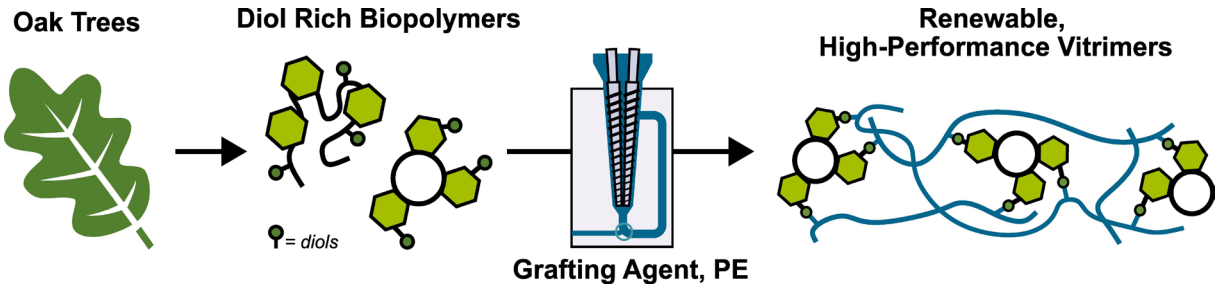

Figure 1: Schematic of renewable high-performance vitrimer synthesis through reactive extrusion of biopolymers, using a boronic acid derivative as a grafting agent.