Biomimetic Composites With Natural Fiber Reinforced, Recyclable Biobased Benzoxazine Resins

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Historically, petroleum-based polymers have been used internationally for everyday objects such as telephones, grocery bags, cars, etc. More often than not, these polymers have negatively impacted the earth, producing non-biodegradable waste and extensive carbon emissions. However, material sciences are undergoing a paradigm shift, focusing on the use of natural inputs to produce low-carbon, biodegradable outputs. My research seeks to develop a material that possesses multiple multifaceted properties using biomimetic composites with natural fiber-reinforced, recyclable biobased benzoxazine resins that matches the structural standards of synthetic, non-biobased polymers. For reference, benzoxazine is a macromolecule in which an oxazine ring (heterocyclic six-membered ring) is attached to a benzene ring. The development of this proposed composite system has many advantages for future transportation, such as electric cars, because of its high-performing thermal properties and economically attractive raw material. My goals were threefold: i) to synthesize an ester with naturally available diols, phenolic derivatives, and primary amines, ii) to synthesize benzoxazine with the prepared ester, formaldehyde, and primary amines, and iii) recrystallization and characterization of the bio-based benzoxazine resin. I used transesterification procedures to synthesize the target benzoxazine and used nuclear resonance spectroscopies (NMR) to confirm the structure of the crude product at the atomic level. Results suggest that the goal benzoxazine has been synthesized, but I need to perform more characterization tests to confirm that the structural properties of this new polymer match those of non-biodegradable, synthetic products available today.

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