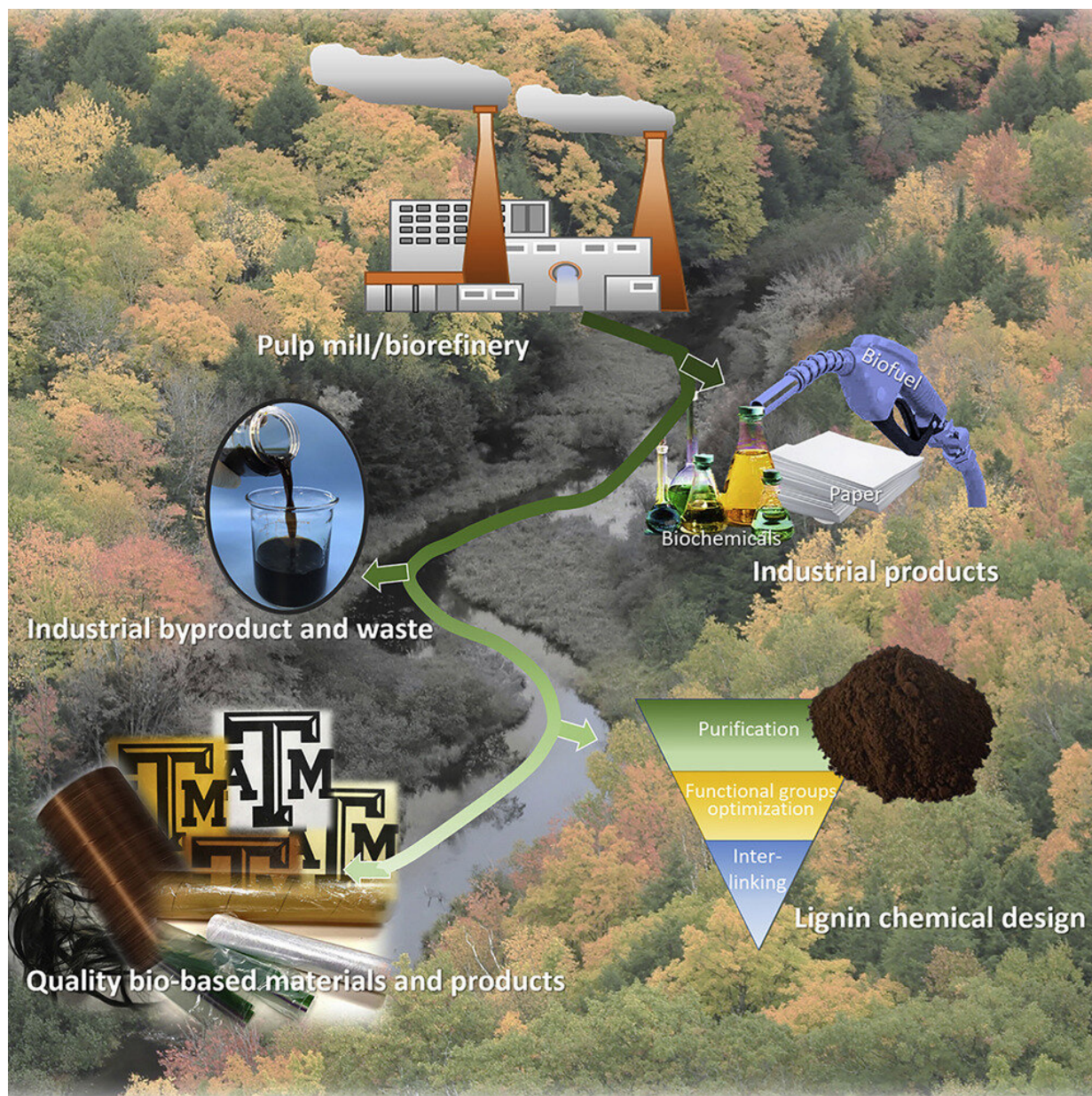


By design: From waste to next-gen carbon fiber

August 18 2022, by Brandie Jefferson



Graphical abstract. Credit: *Matter* (2022). DOI: 10.1016/j.matt.2022.07.011

Research from Washington University in St. Louis may soon lead to lighter, stronger carbon fiber materials and stronger plastics with a gentler environmental impact. The main ingredient necessary for these improvements is lignin, a compound that is essential for most plants but considered a waste product by industry.

The key to opening up lignin's potential was chemically altering some of its properties. High Molecular Weight Esterified Linkage Lignin (HiMWELL) was designed by the group of Joshua Yuan, professor and chair of the Department of Energy, Environmental & Chemical Engineering at Washington University in St. Louis' McKelvey School of Engineering.

The research was published Aug. 11 in the journal *Matter*.

Researchers knew that, combined with polyacrylonitrile (PAN), the newly designed HiMWELL lignin could become a precursor to a better carbon fiber and that it could enable the development of recyclable plastics with better properties, as well.

Already, carbon fiber is known for being a strong and stiff, yet light—and premium—material. It is used as structural reinforcement in everything from tennis rackets to airplanes, and carbon fiber frames reduce weight and improve safety in high-end vehicles. It has been incorporated anywhere possible in some of the fastest super and hypercars.

Yuan's previous work identified three main roadblocks to incorporating lignin in the equation: neither lignin's chemical structure nor its

[molecular weight](#) is uniform, which makes it difficult to combine with other polymers. And it has a high number of OH groups, a reactive pairing of oxygen and hydrogen that attracts water—not ideal for building a rigid material like carbon fiber. These discoveries inspired Yuan and Jinghao Li, a senior scientist at Washington University, to redesign lignin structures.

By developing a technique to chemically alter these properties, Yuan said, "We've really created a type of lignin that is very unique."

When combined with PAN, the HiMWELL-based carbon fiber had a record [tensile strength](#) and showed better [mechanical properties](#) than standard [carbon fiber](#). When it was added to recyclable polymer blends, HiMWELL improved mechanical properties and also improved UV protection.

"Finally, we have a technological path for [lignin](#) to be used for carbon fibers," Yuan said. And perhaps one day, "You'll turn this waste into the shell of a car."

More information: Jinghao Li et al, Lignin molecular design to transform green manufacturing, *Matter* (2022). [DOI: 10.1016/j.matt.2022.07.011](#)

Provided by Washington University in St. Louis

Citation: By design: From waste to next-gen carbon fiber (2022, August 18) retrieved 12 September 2024 from <https://phys.org/news/2022-08-next-gen-carbon-fiber.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is

provided for information purposes only.