UMD Researchers Create Super Wood Stronger Than Most Metals

ENGINEERS AT THE University of Maryland (UMD) have found a way to make wood more than ten times stronger and tougher than before, creating a natural substance that is stronger than many titanium alloys.

"This new way to treat wood makes it twelve times stronger than natural wood and ten times tougher," said Liangbing Hu, the leader of the UMD team that did the research, published in the journal *Nature*. "This could be a competitor to steel or even titanium alloys, it is so strong and durable. It's also comparable to carbon fiber, but much less expensive." Hu is an associate professor of materials science and engineering and a member of the Maryland Energy Innovation Institute.

"It is both strong and tough, which is a combination not usually found in nature," said Teng Li, the co-leader of the team and the Samuel P. Langley Professor of mechanical engineering at the University of Maryland. His team measured the dense wood's mechanical properties. "It is as strong as steel, but six times lighter. It takes 10 times more energy to fracture than natural wood. It can even be bent and molded at the beginning of the process."

The team's process begins by removing the wood's lignin, the part of the wood that makes it both rigid and brown in color. Then it is compressed under mild heat, at about 150˚ F. This causes the cellulose fibers to become very tightly packed. Any defects like holes or knots are crushed together. The treatment process was extended a little further with a coat of paint.

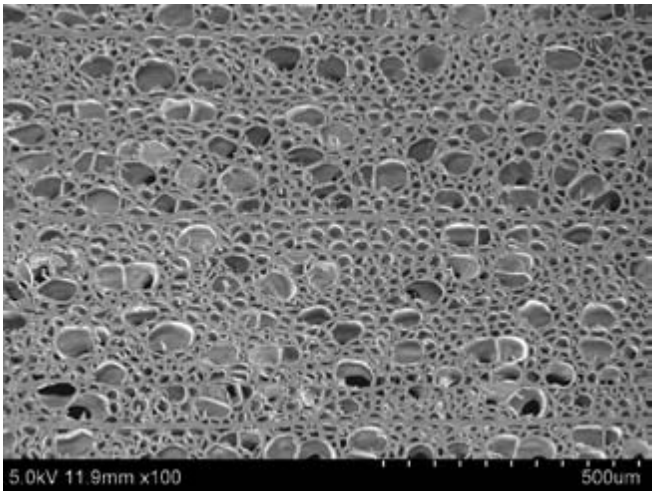
The scientists found that the wood's fibers are pressed together so tightly that they can form strong hydrogen bonds, like a crowd of people who can't budge—who are also holding hands. The compression makes the wood five times thinner than its original size.

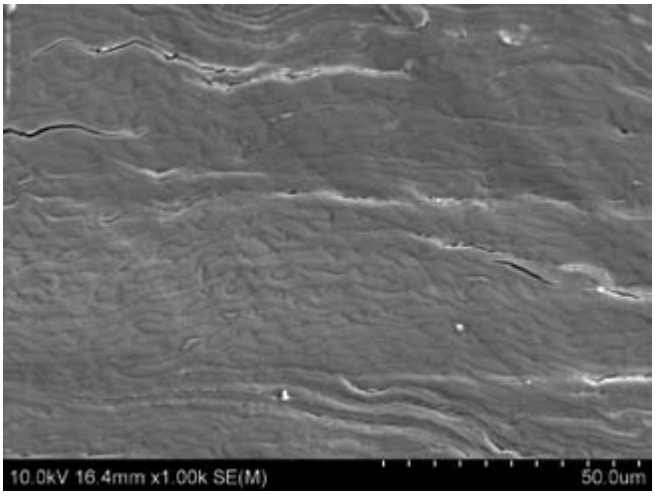
The team tested their new wood material and natural wood by shooting bullet-like projectiles at it. The projectile blew straight through the natural wood. The fully treated wood stopped the projectile partway through.

"Soft woods like pine or balsa, which grow fast and are more environmentally friendly, could replace slower-growing but denser woods like teak, in furniture or buildings," Hu said.

"The paper provides a highly promising route to the design of light weight high performance structural materials, with tremendous potential for a broad range of applications where high strength, large toughness and superior ballistic resistance are desired, " said Dr. Huajian Gao, a professor at Brown University, who was not involved in the study. "It is particularly exciting to note that the method is versatile for various species of wood and fairly easy to implement."

"This kind of wood could be used in cars, airplanes, buildings—any application where steel is used," Hu said. "The





Magnified images of (1) untreated wood and (2) the same wood treated by a new process invented by engineers at the University of Maryland that compresses the natural structures of wood into a new material five times thinner. Image Credit: University of Maryland.

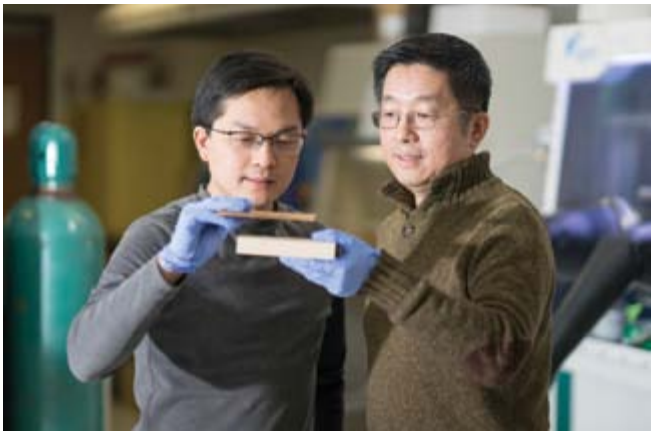
two-step process reported in this paper achieves exceptionally high strength, much beyond what [is] reported in the literature," said Dr. Zhigang Suo, a professor of mechanics and materials at Harvard University, also not involved with the study. "Given the abundance of wood, as well as other cellulose-rich plants, this paper inspires imagination."

"The most outstanding observation, in my view, is the existence of a limiting concentration of lignin, the glue between wood cells, to maximize the mechanical performance of the densified wood. Too little or too much removal lowers the strength compared to a maximum value achieved at intermediate or partial lignin removal. This reveals the subtle balance between hydrogen bonding and the adhesion imparted by such polyphenolic compound. Moreover, of outstanding interest, is the fact that wood densification leads to both, increased strength and toughness, two properties that usually offset each other," said Orlando J. Rojas, a professor at Aalto University in Finland.

Hu's research has explored the capacities of wood's natural nanotechnology. They previously made a range of emerging technologies out of nanocellulose related materials: (1) super clear paper for replacing plastic; (2) photonic paper for improving solar cell efficiency by 30%; (3) a battery and a supercapacitor out of wood; (4) a battery from a leaf; (5) transparent wood for energy efficient buildings; (6) solar water desalination for drinking and specifically filtering out toxic dyes. These wood-based emerging technologies are being commercialized through a UMD spinoff company, Inventwood LLC.

About the University of Maryland

The University of Maryland, College Park, is the state's flagship university and one of the nation's preeminent public research universities. A global leader in research, entrepreneurship and innovation, the university is home to more than 40,000 students, 10,000 faculty and staff, and 280 academic programs. Its faculty includes two Nobel laureates, three Pulitzer Prize winners, 60 members of the national academies and scores of Fulbright scholars. The institution has a $1.9 billion operating budget and secures $514 million annually in external research funding. For more information about the University of Maryland, College Park, visit www.umd.edu.



Liangbing Hu (left) holds a block of wood transformed by a new process to become stronger than rivals titanium and tougher than steel. Teng Li (right) holds an untreated block of the same wood. Image Credit: University of Maryland.

INDUSTRY NEWS

Wheelabrator Group Consolidates North American Operations, Expands Georgia Hub

Wheelabrator Group Inc., a Norican Group company, announces it will be consolidating its North American operations, centralizing both sales and engineering by creating a NA Region Hub at its LaGrange GA facility. The company's Burlington, Ontario facility will close in a phased shutdown and services will transition to LaGrange by the end of 2018.

Wheelabrator NA Sales and Service Leader Marty Magill commented, "It's challenging to make such a significant change to our business when it impacts highly valued employees. We have not taken the decision lightly and we thank our loyal team for their contribution to our success. The centralization of our Wheelabrator NA business allows us to join our sales and technology teams under one roof. This has become necessary to ensure we can move swiftly to meet customer needs for equipment, parts and service technology in an increasingly 'just-in-time' manufacturing landscape."

The LaGrange facility will become the headquarters for all NA sales and service operations, engineering and technology development and the Customer Application Lab.

Wheelabrator will continue to leverage its flexible manufacturing footprint to strengthen the parts and equipment offering and improve both lead times and service levels. The company expects to expand its Monterrey, Mexico operations in 2018.

Pierre Tanguay, NA Supply Chain leader said, "Our mission is to exceed our customer's expectations and help them thrive in a fast-paced, highly competitive market. The flexibility of our sourcing, manufacturing and distribution model is critical to our commitment to provide competitively priced, best-in-class technology solutions."