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Wood that Is as Tough, Hard, and Strong as Steel

It seems like yesterday that I was teaching students about soft and hard woods. How the trees that they came from, that are classified by their type of leaves, determined the wood's basic hardness and other characteristics. The wood that I am

and Dr. Teng Li are the material science and engineering professors that led the team that turned common wood into a material that is as strong as steel.

My statement on the properties of this processed wood seems so outrageous that I feel it necessary to quote the opening sentence of the UMD news release (<http://snip.li/D89k>) that heralded their material science breakthrough: "Engineers at the University of Maryland 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." Photo 1 shows a piece of their densification processed wood stopping a bullet that would normally go through wood as if it

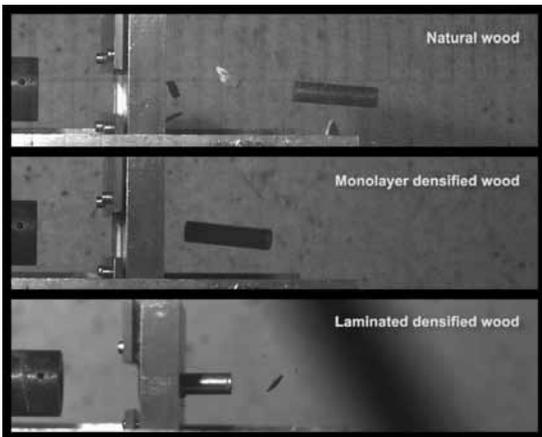
walls that nature has learned how to build by combining hemicellulose and cellulose fibers. The wood has a third chemical ingredient called lignin, in and between these hard-walled cells, that acts as a natural glue and gives the wood its ability to resist compression. It is the combination of these three ingredients that gives wood its structure, hardness, and has made wood the perfect building material for thousands of years.

To compress the wood using their densification process, the scientific team determined that it was necessary to remove most of the hemicellulose fibers that increase the stiffness of the cell walls and remove most of the lignin that prevents the compression of the cells. The researchers theorized that once these two ingredients were removed the wood wouldn't resist compression.

The goal of their research was to find a way to leave the cellulose structure of the wood alone while reducing the other two natural wood ingredients that naturally resisted densification. Photos 2 and 3 show the wood's structure under a microscope before and after densification.

The first step of their process uses the same boiling bath and chemicals that are used to make paper. The major difference in this

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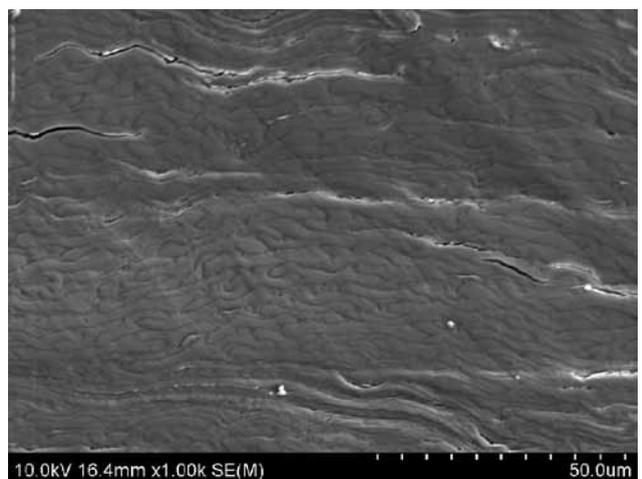
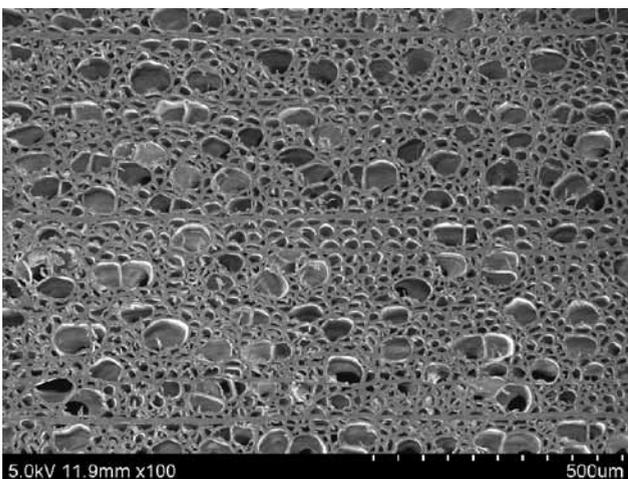
Photos courtesy University of Maryland

Photo 1—In the movies, just about everything can stop a high-speed bullet. In reality, a bullet will penetrate undensified lumber without much loss of velocity.

going to describe left the forest as a soft or hard wood and gained its new properties in a lab at the University of Maryland (UMD). Dr. Liangbing Hu

was going through paper.

To understand their densification process, you need to know that wood, like all plants, has hard cell



Photos 2 & 3—Wood cells, under magnification, before (left) and after the densification process.

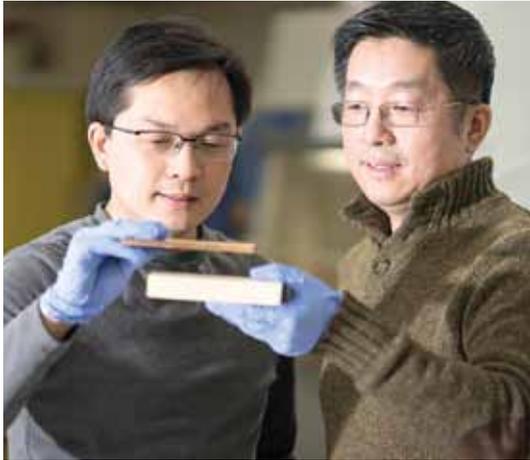


Photo 4—Dr. Liangbing Hu and Dr. Teng Li are holding wood that was once the same thickness. The thinner one was reduced in thickness by their densification process.

first step between the paper making process and their densification process is the wood. In their process, it's being treated as a solid board rather than wood chips.

The next step is to warm the wood and place it in a press to subject it to extremely high compres-

sion to squish the wood cells in the board, so they are approximately one fifth of their natural cell size (Photo 4). The team determined that the pressure treatment causes all the atoms in the wood to form hydrogen bonds. A wood finish was used to prevent the wood from absorbing moisture during some of the testing. The result is a piece of wood that is as tough, hard, and strong as steel.

Taking it a Step Further

Wood that has all the characteristics of steel could enter the world of manufacturing, construction, art, and home crafts in so many ways.

1. What do you think will be the first commercial use for densified wood?
2. Why would this wood be labeled as a renewable resource? ☺

Puzzle corrections Answers

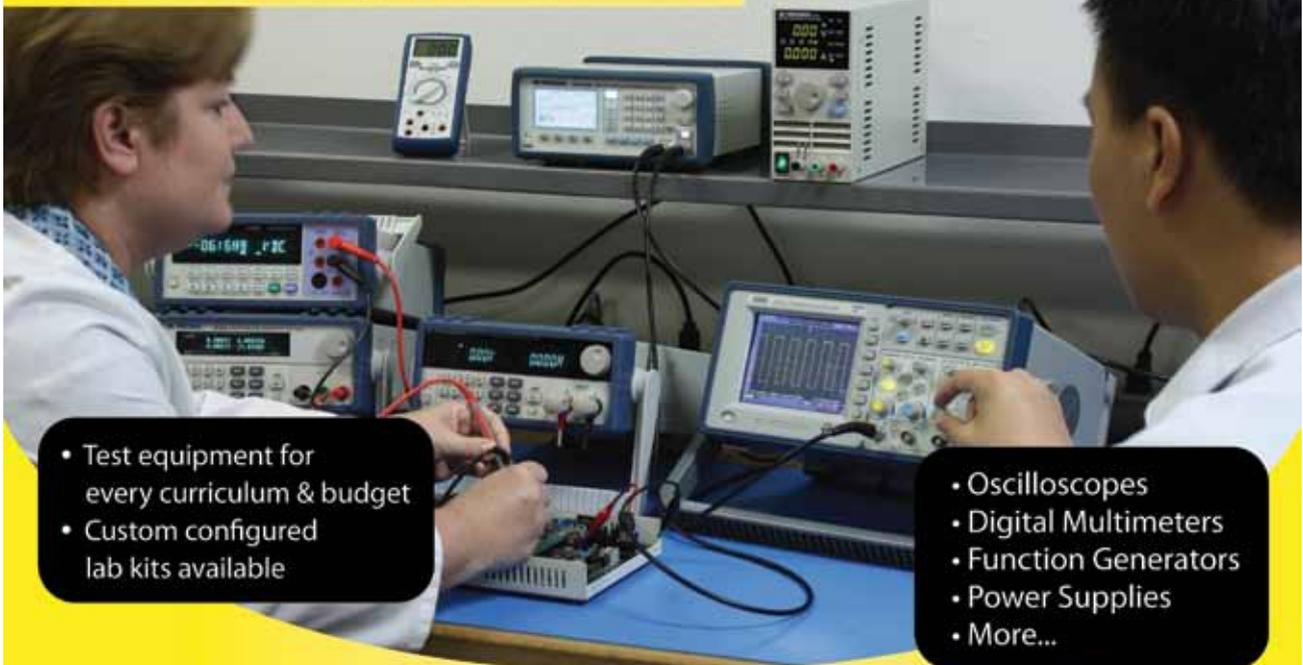
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G 7	0	5		H 1	0	0
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K 2	5		2		L 5	0
	M 8	N 9	5	O 3	0	
P 6	3	9		Q 1	1	R 7
S 3	7	9		T 3	9	5

Builder's Word Search Answers

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