New study is a step toward creating planes that travel at hypersonic speed

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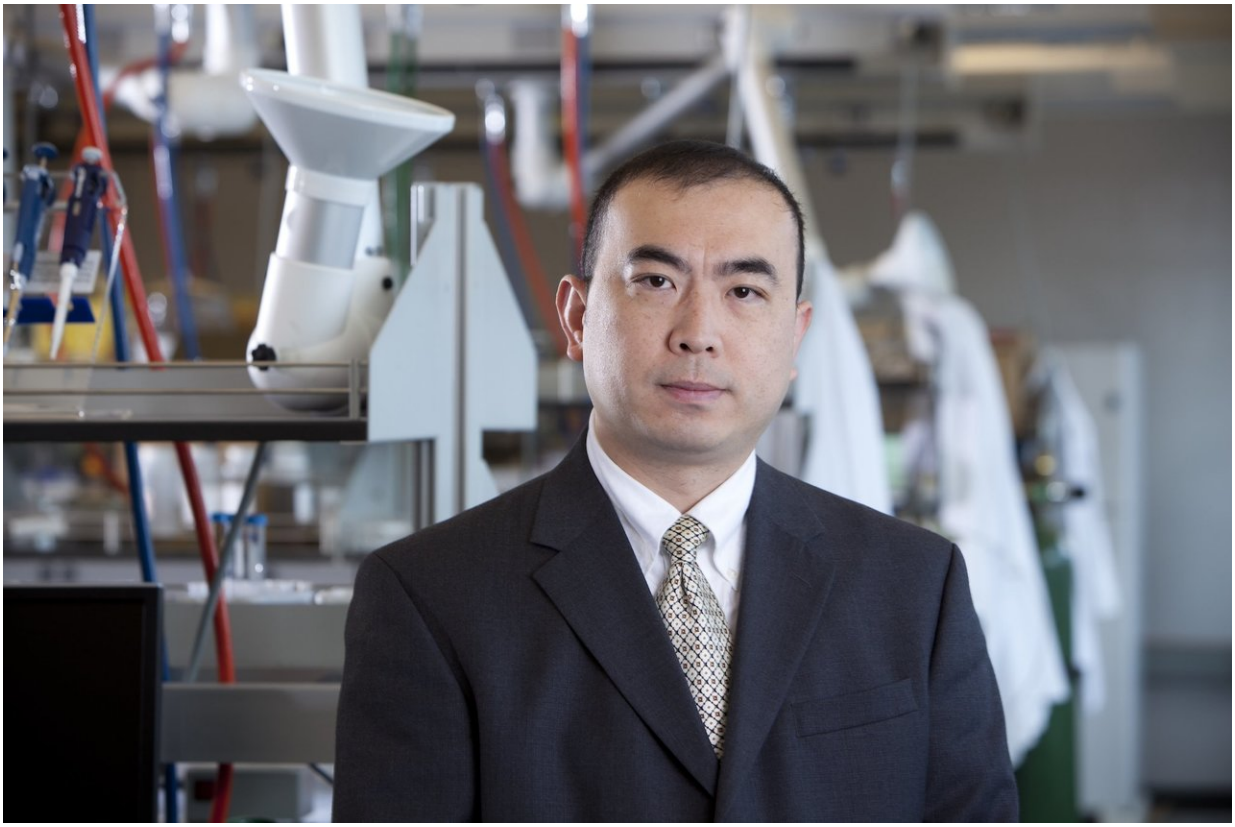

Binghamton University Associate Professor of Mechanical Engineering Changhong Ke. Credit: Binghamton University, State University of New York

An average flight from Miami to Seattle takes about six hours and 40 minutes, but imagine being able to reduce that time to 50 minutes or less.

A recent study by researchers at NASA and Binghamton University, State University of New York, could lead to a drastic decrease in flight times. The study, funded in part by the U.S. Air Force, is one of the first steps toward the creation of planes able to move at hypersonic speeds, five to 10 times the speed of sound.

There are currently quite a few obstacles when it comes to building these super planes, said Binghamton University Associate Professor of Mechanical Engineering Changhong Ke. The first of which is finding a material that can hold up to hypersonic travel.

"Our study used what are called boron nitride nanotubes (BNNTs). NASA currently owns one of the few facilities in the world able to produce quality BNNTs," said Ke. Typically, carbon nanotubes have been used in planes for their strength—they're stronger than steel—and their ability to conduct heat. However, BNNTs are the wave of the future when it comes to air travel.

"While carbon nanotubes can stay stable at temperatures up to 400 degrees Celsius, our study found that BNNTs can withstand up to 900 degrees Celsius," said Ke. "BNNTs are also able to handle high amounts of stress and are extremely lightweight."

Withstanding high temperatures is an important requirement for any material meant to build the world's next super planes. However, Ke clarified that the material has to be able to maintain both structural and mechanical properties in an oxygen environment.

"We weren't testing this material in a vacuum, like what you would experience in space. Materials can withstand much higher temperatures in space. We wanted to see if BNNTs could hold up in the type of environment an average fighter jet or commercial plane would experience," he said.

While the study has brought new light to the strength and stability of BNNTs, their use on planes may not be a reality for another five to 10 years.

"Right now, BNNTs cost about $1,000 per gram. It would be impractical to use a product that expensive," said Ke.

But, that does not mean it will never happen. Carbon nanotubes were about the same price 20 years ago. As more studies indicated the usefulness of carbon nanotubes, the production rates increased and prices went down to the current rate, between $10 and $20 per gram. Ke sees the same fate coming down the line for BNNTs.

Ke plans to continue this type of research on BNNTs. He has worked with the U.S. Air Force on several research projects and in 2010 was chosen for the U.S. Air Force's Young Investigator Research Program, a prestigious program with fewer than 20 percent of applicants accepted. While the advances of BNNTs will probably be used first in fighter jets, Ke said he can see this type of technology trickling down to commercial flights.

The paper, "Quantitative Characterization of Structural and Mechanical Properties of Boron Nitride Nanotubes in High Temperature Environments," was published in *Scientific Reports*.

More information: Xiaoming Chen et al, Quantitative Characterization of Structural and Mechanical Properties of Boron Nitride Nanotubes in High Temperature Environments, *Scientific Reports* (2017). DOI: 10.1038/s41598-017-11795-9

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