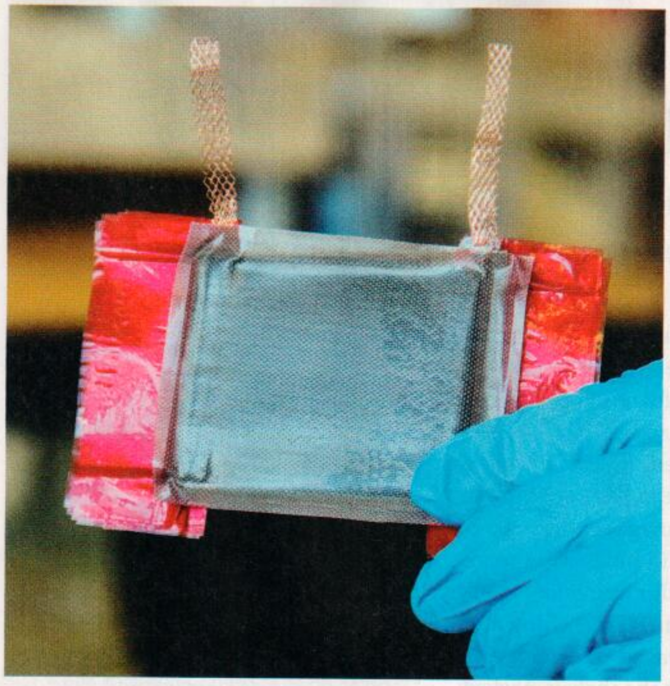

A new film of carbon nanotubes cures composites for airplane wings and fuselages but uses only 1 percent of the energy required by traditional oven-based manufacturing processes.

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A Simpler Recipe for Airplanes

Carbon nanotube film could let manufacturers "bake" aircraft composites without a giant oven.

Composite materials used in aircraft wings and fuselages are typically manufactured in very large, house-size ovens: multiple polymer layers are blasted with temperatures of up to 400 °C to form a solid, resilient material. With this approach, considerable energy is required to heat first the oven, then the gas within the oven, and finally the actual composite.

Aerospace engineers at MIT have now developed a carbon nanotube film that can accomplish the same end without these massive ovens. When wrapped over a multilayer polymer composite and connected to an electrical power source to heat it up, the film stimulates the polymer to solidify.

The group tested the film on a common carbon-fiber material used in aircraft components and found that it created a composite as strong as that manufactured in conventional ovens—using only 1 percent as much energy.

The new "out-of-oven" approach may offer a more direct energy-saving method to manufacture virtually any industrial composite, says Brian L. Wardle, SM '95, PhD '98, a professor of aeronautics and astronautics at MIT.

"Typically, if you're going to cook a fuselage for an Airbus A350 or Boeing 787, you've got about a four-story oven that's tens of millions of dollars in infrastructure that you don't need," Wardle says. "Our technique puts the heat where it is needed, in direct contact with the part being assembled. Think of it as a self-heating pizza ... Instead of an oven, you just plug the pizza into the wall and it cooks itself."

Wardle says the nanotube film, which is just a fraction as thick as the diameter of a human hair, is also incredibly light. After it has fused the underlying polymer layers, it meshes with the composite, adding negligible weight.

The team is working with industrial partners to scale up the technology so that the composites can be used to make airplane fuselages and wings.

The researchers, including MIT graduate students Jeonyoon Lee and Itai Stein and Seth Kessler '99, SM '00, PhD '02, of the Metis Design Corporation, published their results in the journal *ACS Applied Materials and Interfaces*.

—Jennifer Chu

NISHANT CHOKSI

Memory Scale. This analysis revealed that performance on different tasks – such as memorizing numbers, searching for visual elements, and assembling puzzles – peaked at all different ages.

To verify their results, the researchers turned to experiments on the Internet, which makes it much easier to recruit a huge pool of subjects of all ages. Their websites, Gameswithwords.org and Testmybrain.org, feature cognitive tests designed to be completed in just a few minutes.

After studying data from nearly 50,000 subjects, the researchers found a very clear picture showing that each cognitive skill they were testing peaked at a different age. For example, raw speed in processing information appears to peak around 18 or 19 and then immediately starts to decline. Meanwhile, short-term memory continues to improve until around age 25, when it levels off, and then begins to drop around 35.

The ability to evaluate other people's emotional states seems to peak much later, in the 40s or 50s. And while earlier data had shown that crystallized intelligence – the accumulation of facts and knowledge – peaked in the 40s, a vocabulary test found that it is now peaking in the late 60s or early 70s, perhaps because of increases in education, reading-intensive jobs, and opportunities for intellectual stimulation later in life.

More work is needed to explain these results, but previous studies have hinted that genetic changes or changes in brain structure may play a role. *—Anne Trafton*