Engineers develop new air filter that could help Beijing residents breathe easily

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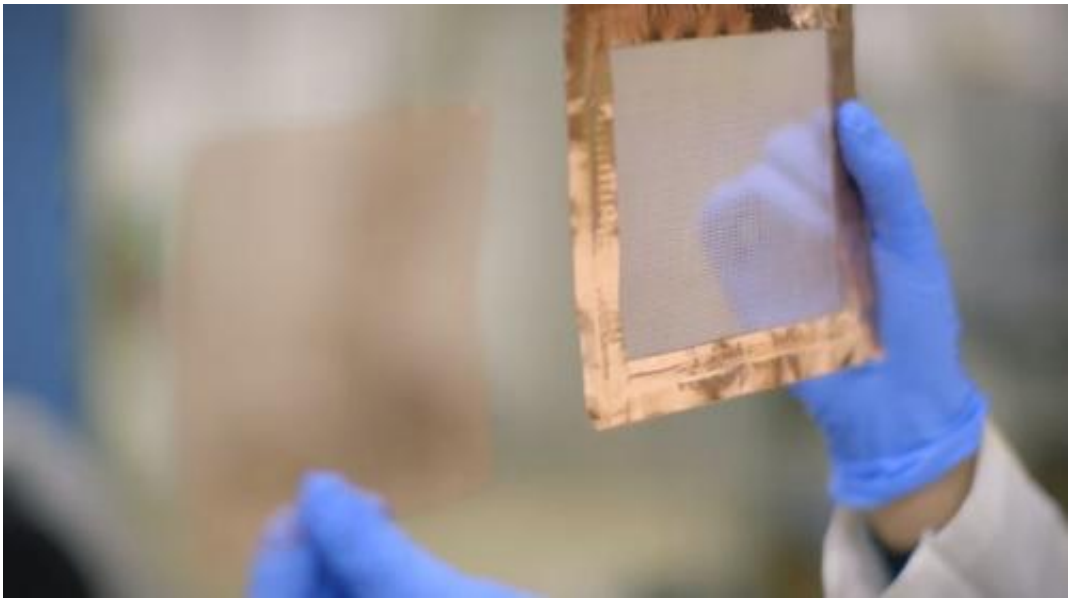

In the past few years, Yi Cui has made several business trips to China. Each time he has found himself choked by smog produced by automobiles and coal power plants.

After a few of these trips, Cui, an associate professor of materials science and engineering at Stanford, came up with an idea to clean the pollution. He and his graduate students set to work designing an inexpensive, efficient air filter that could ease the breathing for people

in polluted cities.

"My lab group really likes to solve problems, even if it's something we've never worked on," Cui said. "We think we could use this material for personal masks, window shades and maybe automobiles and industrial waste. It works really well, and it might be a game-changer."

The work is published in the current issue of the journal *Nature Communications*.

This was the first time Cui's group had designed an air filter – Cui's work with nanomaterials focuses primarily on battery technology – so he and his students didn't immediately look to materials that have traditionally been used in air filters.

Instead, they looked for polymers that would have a strong attraction to the main components of smog, particularly particle matters that are smaller than 2.5 microns, known as PM2.5. These pose the greatest risk to the human respiratory system and overall health; current filtration systems that can remove them from the air are very energy-intensive.

It turned out that polyacrylonitrile (PAN), a material commonly used to make surgical gloves, met these requirements.

"It was mostly by luck, but we found that PAN had the characteristics we were looking for, and it is breathtakingly strong," said Po-Chun Hsu, co-author on the study and a graduate student in Cui's lab.

Using a technique called electrospinning, the researchers converted liquid PAN into spider-web-like fibers that are just a thousandth the diameter of a human hair. In the study, the researchers approximated Beijing's smog by flowing smoke from burning incense over different densities of the fiber, and later performed a field test in Beijing. The

final material allows about 70 percent transparency and yet collects 99 percent of the particles.

"The fiber just keeps accumulating particles, and can collect 10 times its own weight," said Chong Liu, lead author on the paper and a graduate student in Cui's lab. "The lifespan of its effectiveness depends on application, but in its current form, our tests suggest it collects particles for probably a week."

The first two immediate applications, Cui said, would probably be simple passive systems, such as personal masks and window screens, or possibly hospital air filtration systems.

"The transparency and distance between the fibers means that light and air can pass through very efficiently, which makes it a very good application for windows," Cui said. "It might be the first time in years that people in Beijing can open their window and let in a fresh breeze."

The material might also have a place filtering exhaust from cars, or from the smoke stacks of power plants and industrial complexes. These applications, Cui said, would require additional testing of the material to ensure that it is robust enough to withstand other acidic or toxic compounds in these types of exhaust.

More information: "Transparent air filter for high-efficiency $PM_{2.5}$ capture." *Nature Communications* 6, Article number: 6205 DOI: 10.1038/ncomms7205

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