Copper coating on 3-D-printed plastic filters proposed as a pandemic fighter

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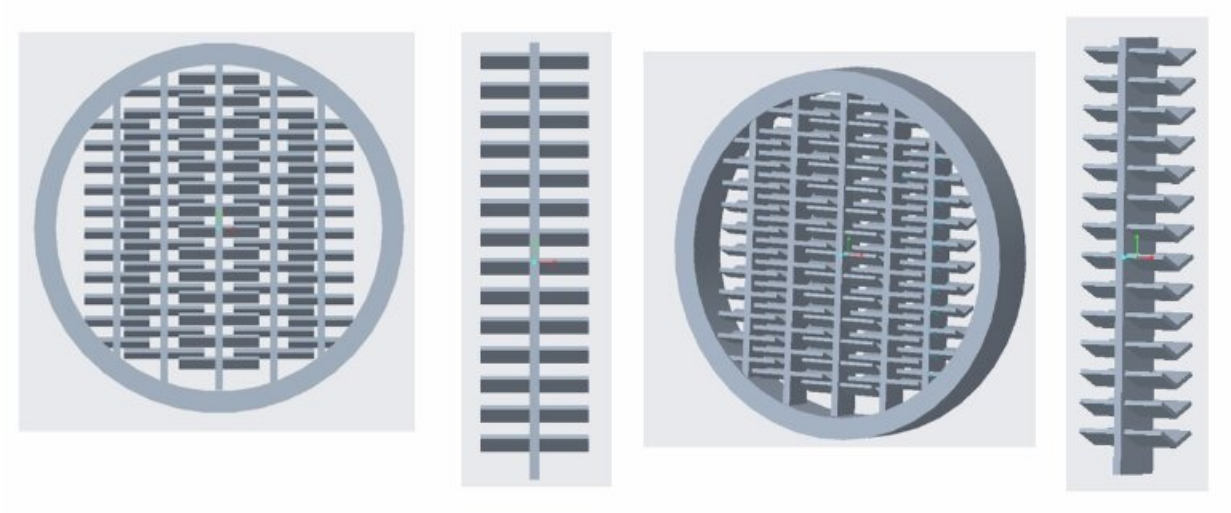

In the prototype of the mask's filter, a ring with V-shape "fins" was designed to increase the surface area where air passes through more channels. Credit: Jing Zhang, School of Engineering and Technology

In the ongoing fight against COVID-19, experts on microbiology and copper are recommending an expanded use of the metal to reduce the virus's spread. So might copper be incorporated into the construction of masks, the universally accepted virus-fighting personal item?

That's what Jing Zhang of the School of Engineering and Technology at IUPUI and a team of researchers are doing, using a copper coating on

3-D-printed plastic filters to create more-efficient masks and respirators.

"One study in 2015, funded by the U.S. Department of Defense, said that a copper alloy can kill 58 percent of infections," said Zhang, an associate professor in the Department of Mechanical and Energy Engineering. "We can use copper plating to cover some frequently touched surfaces such as doorknobs and elevator buttons; that inspired me to see how we could combine what looks like almost a magic metal into a mask design."

The challenge was to find a structure that blocks out tiny aerosol particles while also providing proper ventilation for breathing, and nature had an answer—the gills on fish. Gills allow fish to draw oxygen from water, and that design is incorporated into the prototype mask.

"We know how nature works, so we had to figure out how we could make that into an artificial structure," said Zhang, whose research interests in 3-D printing came into play.

In the prototype, a ring with V-shape "fins," an analogous structure to the gill filament, was designed to increase the surface area where air passes through more channels. Two approaches to creating that are using a green-laser metal 3-D printer to directly reproduce the complex copper structure or, in an even more economical way to create the design, 3-D-printing a plastic structure followed by electroplating, in which the 3-D-printed plastic component is merged in a liquid solution full of copper ions and the ions are migrated and cover the surface under electric field.

Collaborator Jingzhi Pu, from the Department of Chemistry and Chemical Biology in the School of Science at IUPUI, is continuing to look at how copper ions deactivate the function of the virus using molecular dynamics simulations. Fellow collaborator Ryan Ford Relich, director of clinical microbiology and serology at Eskenazi Health, is

helping in laboratory tests that will hopefully lead to a working prototype by October. Graduate students in Zhang's group, Xuehui Yang and Tejesh Dube, are also assisting on the project.

"I think this can be used on a daily basis while also being applied to other systems, such as air vent filters in buildings and airplanes, that require long-term use," Zhang said. "Copper is reusable and easy to clean, very affordable, and environmentally friendly."

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