Researchers develop antiviral face mask that can capture, deactivate SARS-CoV-2 spike protein on contact

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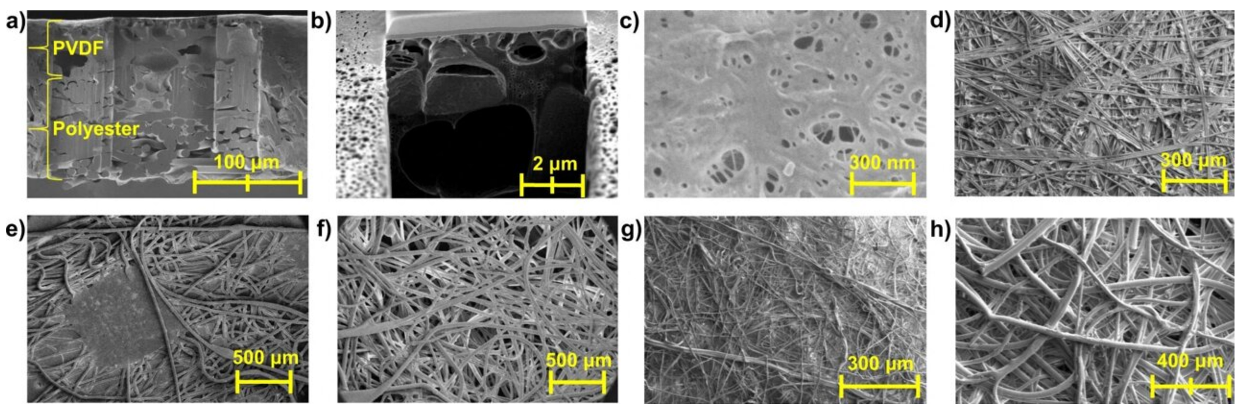

(a) full thickness cross-section of PVDF400 and (b) PVDF-only layer cross-section. Surface of (c) PVDF layer and (d) polyester support layer. SEM images of N95 layers (e) 1, (f) 2, (g) 3, and (h) 4. In mask orientation, layer 1 is exposed to the open environment and layer 4 is exposed to the inside of the mask. Layer 3 is referred to as the "separating" layer, as it had the highest flow resistance. Credit: University of Kentucky

A team of University of Kentucky researchers led by College of Engineering Professor Dibakar Bhattacharyya, Ph.D., and his Ph.D. student, Rollie Mills, have developed a medical face mask membrane that can capture and deactivate the SARS-CoV-2 spike protein on contact.

At the beginning of the COVID-19 pandemic in 2020, Bhattacharyya, known to friends and colleagues as "DB," along with collaborators across disciplines at UK set out to create the material. Their work was published in *Communications Materials* on May 24.

SARS-CoV-2 is covered in spike proteins, which allow the virus to enter host cells once in the body. The team developed a membrane that includes proteolytic enzymes that attach to the protein spikes and deactivates them.

"This new material can filter out the virus like the N95 mask does, but also includes antiviral enzymes that completely deactivate it. This innovation is another layer of protection against SARS-CoV-2 that can help prevent the virus from spreading," said DB, the director of UK's Center of Membrane Sciences. "It's promising to the development new products that can protect against SARS-CoV-2 and a number of other human pathogenic viruses."

DB's team included J. Todd Hastings, Ph.D., Thomas Dziubla, Ph.D., and Kevin Baldridge, Ph.D. from the College of Engineering; Yinan Wei, Ph.D., a former professor in the College of Arts and Sciences' Department of Chemistry; and Lou Hersh, Ph.D., in the College of Medicine's Department of Molecular and Cellular Biochemistry. College of Engineering doctoral student Rollie Mills (NSF Graduate Fellow and first author of the article), and undergraduate students Ronald Vogler, Matthew Bernard and Jacob Concolino contributed extensively to the project.

The team developed the membrane, which was fabricated through an existing collaboration with a large-scale membrane manufacturer. It was then tested using SARS-CoV-2 spike proteins that were immobilized on synthetic particles. Not only could the material filter out coronavirus-sized aerosols, but it was also able to destroy the spike proteins within 30 seconds of contact.

The study reports that the membrane provided a protection factor above the Occupational Safety and Health Administration's standard for N95 masks, meaning that it could filter at least 95% of airborne particles.

"These membranes have been proven to be a promising system of advancement toward the new generation of respiratory face masks and enclosed-environment filters that can significantly reduce coronavirus transmission by virus protein deactivation and enhanced aerosol particle capture," the study reports.

The new membrane builds upon the center's National Institute of Environmental Health Sciences (NIEHS) and NSF-funded activities, which have developed various functionalized membranes for environmental remediation. In contrast to passive membranes, functionalized membranes provide additional benefits by interacting with undesired particles like viruses through selective binding or deactivation.

More information: Rollie Mills et al, Aerosol capture and coronavirus spike protein deactivation by enzyme functionalized antiviral membranes, *Communications Materials* (2022). DOI: 10.1038/s43246-022-00256-0

Provided by University of Kentucky