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Silk Protein Nanofiber Filter With Antiviral Activity Against Viral Aerosols

Sanchao Liu Army Research Lab **Hong Dong** Army Research Laboratory **Yelena Sliozberg** Army Research Laboratory

Our nation faces various biological threats ranging from viruses in nature such as the SARS or MERS, to the potential of deliberate biological weapon attacks. A more effective antiviral filter would provide enhanced protection for soldiers and civilians. Current commercial filters only block microsized particle aerosols at certain levels but are not capable of specific viral capture or subsequent neutralization. Our research focuses on developing a new type of bioactive antiviral filters aiming for higher filtration efficiency, viral capture, and deactivation by utilizing innovative material and biochemical strategies. Our silk fibroin nanofiber filters are fabricated with small pores to catch small virus aerosols. The fibroin protein inherently provides bioaffinity to capture viruses, and the integration of antiviral agents neutralize viruses passively without extra treatment. For the first time, the studies successfully demonstrate that the silk nanofiber filters have significantly higher bioaffinity towards the capture of protein-coated nanobeads (used to simulate proteins on viruses) than polymer microfibers in current mask filters. Computer modeling also shows that the virus can be destroyed on these silk nanofiber surfaces. Peptides that can bind specifically to a biological threat can be integrated into the nanofiber filters to further enhance the filter bioaffinity. The new filter technology is not only applicable for masks and air filters against COVID variants, but also applicable to protection from biothreats.