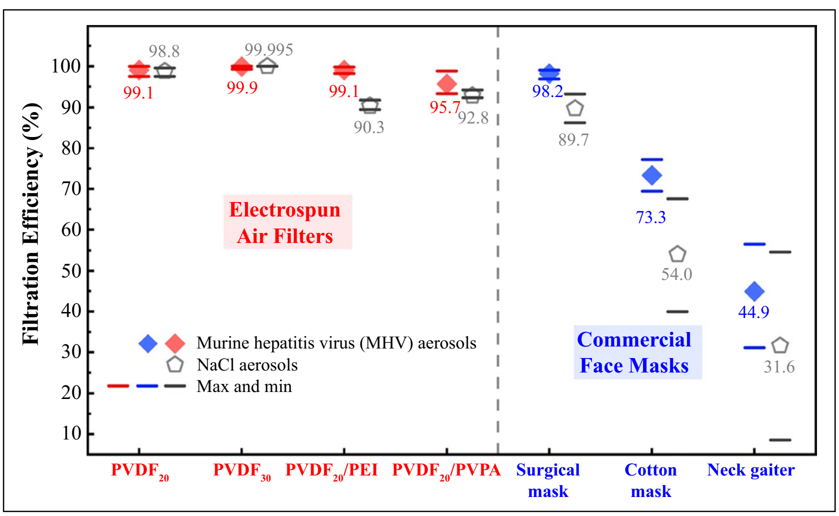
Electrospinning technology controls spread of COVID-19

Several countries are beginning to remove restrictions associated with the COVID-19 pandemic due to low infection levels. Despite this, the spread of COVID-19 by airborne SARS-CoV-2 remains a significant public health problem. It has been shown that virus-laden aerosols <5 μm in size can become airborne for prolonged periods, accumulate in a closed environment, and remain infectious. Although the use of face masks has reduced the spread of the virus, fabric masks do not always have satisfactory aerosol removal efficiency, droplet repellency, and/or breathability. Researchers Yun Shen and colleagues at the University of California, Riverside, and George Washington University have used electrospinning technology to synthesize nonwoven nanofibrous membranes for better filtration. One of the main advantages of electrospinning is that it operates under a strong electric field and produces filters with long-lasting retained charges that can capture aerosols through electrostatic attraction.

Although electrospun nanofiber membranes have shown excellent performance in removing aerosols generated from polystyrene beads, NaCl, and bacteria, the research group used coronavirus aerosols to challenge their air filters and face masks and evaluated their efficiency, as reported in a recent issue of *Environmental Science & Technology Letters* (https://doi.org/10.1021/acs.estlett.1c00337). They also developed electrospun nanofiber air filters with a reduced pore size that can effectively capture viral aerosols. These electrospun filters comprise poly(vinylidene fluoride) formed with an electrospinning duration of 20 min and 30 min ($PVDF_{20}$ and PDF_{30}, respectively) and polyvinylidene fluoride coated with a charged polyelectrolyte such as poly(ethylamine) ($PVDF_{20}$/PEI) and poly(vinylphosphonic acid) ($PVDF_{20}$/PVPA).



Aerosol filtration efficiency of electrospun air filters and commercial face masks. Aerosols generated from a coronavirus (MHV-A59) and NaCl were used for the tests. Credit: *Environmental Science & Technology Letters.*

Electrospun PVDF air filters have smaller fiber diameters (0.2–1.3 μm) and pore sizes than commercial face masks. A surgical mask has a fiber diameter of 5.7 μm ± 2.8 μm while the neck gaiter showed a fiber diameter of 12.0 μm ± 1.0 μm. A larger fiber diameter corresponded to a larger pore size, indicating that electrospun filters have a higher filtration efficiency for airborne particles than commercial face masks.

The electrospun filters have an average filtration efficiency of ≥ 95.7%, while the commercial face masks have average filtration efficiencies of 44.9%, confirming that the aerosol removal efficiency increased with the decrease in the mask pore size. The research team also demonstrated that an increase in the electrospinning duration and thickness of the air filters enhanced coronavirus aerosol removal (99.9% and 99.1% for $PVDF_{30}$ and $PVDF_{20}$, respectively). The use of a polyelectrolyte coating did not promote removing coronavirus aerosols, and the average filtration efficiencies for $PVDF_{20}$/PEI and $PVDF_{20}$/PVPA were 99.1% and 95.7%, respectively.

J. Arnaldo Méndez-Román