Development of a Combinatory Filtration System for Pollution and Virus Abatement

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The majority (91%) of the world's population lives in places exceeding World Health Organization's air quality guidelines and 7 million people die every year because of air pollution. Particulate Matter less than 2.5 microns in size, PM2.5, is the leading contributor to air pollution which results in cardiovascular diseases like COPD, bronchitis, and lung cancer. Recent studies have shown a strong correlation between ambient air pollution and COVID-19 cases, which has affected the lives of billions of people around the world. Abatement technologies such as ionic and other high-efficiency filtration systems are quite expensive and hence unaffordable to communities with limited resources. The engineering goals for this project are to develop a mask with an optimized mixture of nanoparticles that has a dual capability of particulate matter and virus filtration while being safe for human use. The nanoparticles are chosen for their filtration and biocidal capabilities. Particle filtration efficiency, tested with a wind tunnel and PM2.5 from incense sticks measured by laser particle detectors, improved by ~60% with nanoparticle coatings on N95 and surgical masks. Virus filtration efficiency, tested using nebulized NaCl particles as a virus surrogate, improved by 95% with nanoparticle coated masks. The nanoparticle retention efficacy, tested by simulating a normal 8-hour workday breathing through the mask, was well within the permissible exposure limits. These coated masks and filters have several applications such as in polluted cities, for personal protective equipment, and in air-conditioning and car cabin filters. In conclusion, the chosen combination of nanoparticles provides an effective and safe solution for both particulate matter and viral particle filtration.

Awards Won:

Fourth Award of $500