Development of an Antiviral Electrostatic Precipitator to Prevent Airborne Transmission within Indoor Air Environments by Dry-aerosol Antiviral Coating Method

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The attention on airborne viruses as indoor air pollutants has intensified, given their potential to spread diseases through aerosols. A prime illustration is the global outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), responsible for the recent COVID-19 pandemic, notably in indoor environments. Consequently, ensuring optimal indoor air quality becomes paramount to control the airborne transmission of virus-laden aerosols, mitigating their occurrence and widespread dissemination indoors (Sachs et al., 2022).

In addressing airborne transmission within indoor air environments, the utilization of electrostatic precipitators (ESPs) emerges as an advantageous and established strategy for enhancing air quality in air conditioning systems. ESPs operate by capturing airborne viruses onto a collection plate. Remarkably, ESPs have been acknowledged for their effectiveness in diverse applications, including indoor air purification, such as indoor air purifiers and air handling unit in building (Chen et al., 2020). As a result, significant efforts have been invested in engineering ESPs with antimicrobial properties, aiming to hinder the transmission of infectious viruses via aerosol fomites.

In this study, we developed an antiviral ESP system with antiviral surface treatment on the collection plates by dry-aerosol coating method. The ESP system's capability to eliminate and deactivate aerosolized viruses, including relevant surrogates (MS2 bacteriophage, H1N1, HCoV-229E, and -OC43) representing human and animal respiratory viruses like SARS-CoV-2, was assessed. Moreover, we applied the antiviral ESP system on air handling unit of office, and evaluated its capability to prevent airborne transmission within indoor air environments.

Our study highlights ESPs' potential in managing indoor air pollution, emphasizing their efficiency in bioaerosol removal. We aim to contribute to preventing future outbreaks, like COVID-19, by laying a strong foundation for effective measures.

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