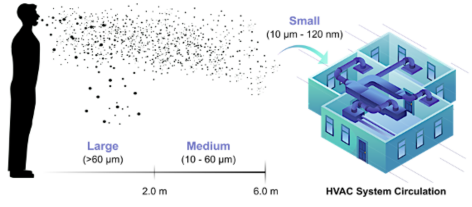
Our Motivation

Transmission of SARS-CoV-2, the virus responsible for the ongoing COVID-19 pandemic, via surfaces and deposited fomites is now considered relatively miniscule in comparison to airborne routes, with the odds estimated to be 1 in 10,000 for real-world encounters.[1-3] Improving indoor air-quality (IAQ) through well-engineered upgrades to heating, ventilation, and air-conditioning (HVAC) systems and filtration technologies are paramount in designing safe indoor shared workspaces, as outlined recently by the Centers for Disease Control and Prevention (CDC) and the American Society of Heating, Refridgerating and Air-Conditioning Engineers (ASHRAE).[4] Even prior to COVID-19, poor IAQ was considered responsible for tens of billions of dollars per annum in lost productivity and healthcare expenses, as estimated by the Environmental Protection Agency (EPA).[5] In the fight against airborne contagion, Curran Biotech is committed to developing energy-efficient air filtration nanotechnologies that sustainably facilitate safe indoor air environments - providing assurance to a returning workforce and building owners/managers.



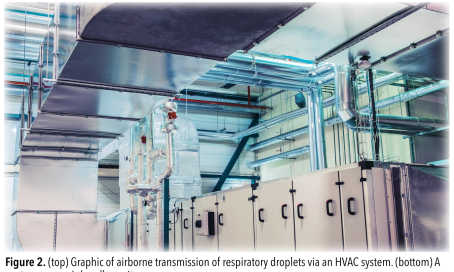


Figure 2. (top) Graphic of airborne transmission of respiratory droplets via an HVAC system. (bottom) A contemporary air-handler unit.

How to Use

Capture Coating™ is a water-based HVAC air-filtration media enhancer compatible with any new pleated polyester, cotton, polypropylene, and/or fiberglass air-filtration media with a minimum efficiency reporting value (MERV) rating of 8 or greater, a filter performance rating (FPR) equal to or greater than 5, and a microparticle performance rating (MPR) equal to or greater than 600. Capture Coating™ is easily applied using spraying or flooding techniques and treated filters are ready for use after 24 hours of drying at room temperature conditions (see TDS). Treated air filters are recommended to be replaced per the filter manufacturer's specifications. Capture Coating™ is currently available nationwide in packaging sizes ranging from 10-ounce spray bottles to 275-gallon IBC totes.

Figure 1. Safe shared workspaces can foster camaraderie and boost overall productivity.

Significance

Mounting scientific evidence suggests that COVID-19, akin to influenza, is seasonally here to stay, compounding existing and novel airborne threats.[6] As such, sustainability and critical HVAC system parameters must be considered in rational engineering and development of novel technologies for air-filtration media in addition to viral filtration and/or virucidal efficacy.[7] Because real-world HVAC systems are designed to operate within specified tolerances to maintain critical setpoints, they are unable to facilely accommodate higher filtration efficiency air-filters without adverse repercussions.

Apart from increasing size exclusion filtration, existing technologies for managing airborne transmission of communicable infectious diseases (CIDs) via HVAC systems are limited to either ultraviolet (UV) germicidal irradiation (UVG) or bipolar ionization mechanisms, both of which are costly to implement/maintain and are energy-intensive. Recent studies show that electronic air cleaning equipment like bipolar ionization systems that ionize return air are likely to generate harmful amounts of reactive oxygen species (ROSs) like ozone, hydroxyl radicals, and superoxide anions that severely degrade IAQ.[8]

Capture Coating™ drastically enhances virus-carrier filtration performance without affecting airflow, static air-pressure, or energy efficiency and can be applied as a retrofit for less than a cup of coffee per filter.

Figure 3. Capture Coating™ is available in an assortment of packaging sizes ranging from 10-ounce spray bottles to 275-gallon totes.

How it Works

Emerging and re-emerging communicable infectious diseases (CIDs) perpetually contribute toward annual global mortalities, imposing a progressively formidable threat against increasingly growing and densifying population centers and their interconnectivity. Transmission of communicable viral respiratory infections are generally believed to involve host inoculation via contact with or inhalation of sub-5-µm diameter virion-containing respiratory fluid droplets from an infected host.[9]

When properly used and applied on appropriately-rated HVAC air-filters, Capture Coating™ enhances air-filtration performance by functionally modifying the surface of the individual fibers comprising the filtration media. This establishes an environment at the filtration media-air interface conducive to enhanced filtration efficiency of aqueous virus/microorganism carriers (e.g., infectious respiratory droplets) beyond manufacture-rated efficiencies via hydrophobic and electrophoretic interaction-based adsorptive filtration, as opposed to size exclusion methods.

Capture Coating™ is partially composed of a non-migrating material that prevents the growth of odor-causing microorganisms and does not foster the conditions that promote the viability and proliferation of viruses like SARS-CoV-2 and other contagion-causing microbes in the form of aqueous virus/microbe carriers expelled from infected individuals and/or animals. When properly used and applied, Capture Coating™ will yield a bacteriostatic, fungistatic, and algistatic surface on the air-filtration media substrate to prevent deterioration and discoloration caused by fungi, algae, and odor- causing bacteria. Capture Coating™ does not create the conditions that promote the development of resistant microorganisms.

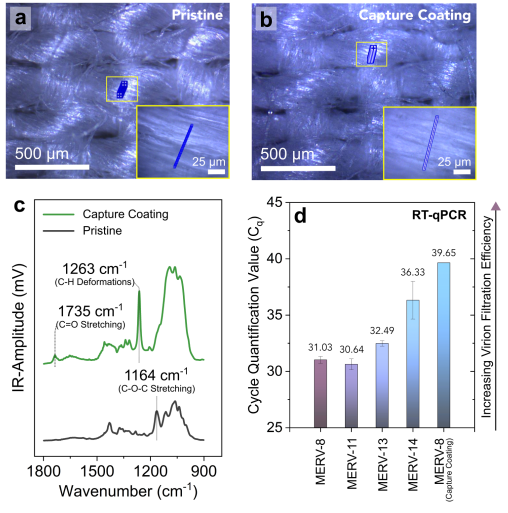


Figure 5. Optical micrographs of a pristine and b Capture Coating™-treated cotton fabric. The line arrays of overlapping blue markers demarcate where sequential optical-photothermal infrared (O-PTIR) spectra were collected, as magnified by the insets. c Averaged O-PTIR spectra of pristine (black) and Capture Coating™-treated (green) cotton, corresponding to panels a and b. d Cycle quantification values from RT-qPCR test results simulating airborne virion transmission through HVAC systems.

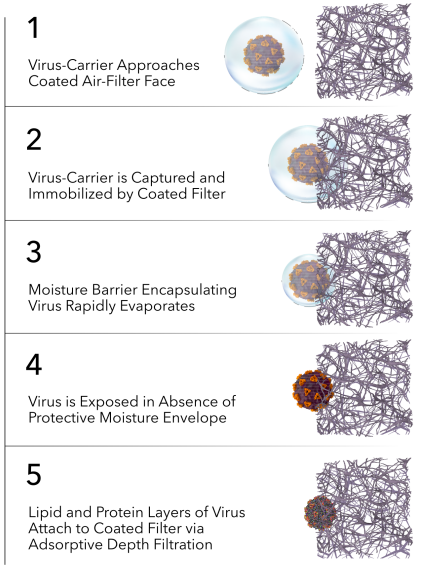


Figure 4. Cartoon illustrating how Capture Coating™ works via adsorptive filtration to enhance the virus-carrier filtration efficiency of air-filtration media.

Independent Testing

Capture Coating™ is a nanoscale system that conformally wraps around individual filtration media fibers, functionally enhancing their virus-carrier filtration performance without affecting energy efficiency or breathability and is detectable spectroscopically (Figure 5a-c). Real-time-quantitative polymerase chain reaction (RT-qPCR) studies using SARS-CoV-2 designed to simulate airborne transmission through HVAC air filters repeatedly show that MERV-8 tri-pleat filters treated with Capture Coating™ outperform MERV-14s, where increasing cycle quantification value indicates less virion transmission through the filter (Figure 5d). Independent studies retained by the Department for Citywide Administrative Services for New York City (NYC) demonstrate how Capture Coating™ negligibly affects (within measurable uncertainty) airflow, static-pressure, and energy consumption using an air-handler unit outfitted with 20 MERV-8 tri-pleat filters supplying a NYC Family Court Service building, as specified in the tables below.

Airflow

Key Parameters	Pre-Install	Post-Install	%-Change
Total CFM	36,325	35,504	-2.3%

Static-Pressure (SP)

Key Parameters	Pre-Install	Post-Install	%-Change
Discharge SP	3.45 in H_2O	3.52 in H_2O	2.0%
Suction SP	-1.35 in H_2O	-1.33 in H_2O	-1.5%
Total SP	4.80 in H_2O	4.85 in H_2O	1.0%

Energy Consumption

Key Parameters	Pre-Install	Post-Install	%-Change
Fan Power Draw	30.1 kW	30.7 kW	2.0%
Annual Energy	94,016 kWh/yr	95,690 kWh/yr	1.8%