NZE/IAQ
NET ZERO ENERGY/INDOOR AIR QUALITY

MEDICAL GRADE INDOOR AIR QUALITY™

Net Zero Energy/Indoor Air Quality™

Welcome to Sterile Safe Solutions, your trusted partner in achieving decarbonization and net-zero goals for large commercial, enterprise, and institutional buildings. We specialize in providing consultancy services that promote energy efficiency and sustainability.

Medical Grade Indoor Air Quality

S3 PROVIDES
MEDICAL GRADE INDOOR AIR QUALITY™

S3 has dedicated years to meticulous research, identification, vetting, and inclusion of mechanical equipment into our carefully curated portfolio. This portfolio encompasses cutting-edge technologies and established legacy technologies specifically tailored for HVAC and mechanical systems, all with a proven track record of enhanced energy efficiency. Our primary goal is to champion what we term "Medical Grade Indoor Air Quality™ (MGIAQ)" across indoor environments, prioritizing the health and safety of occupants.

Our solutions are uniquely designed and engineered to deliver consistent indoor air quality and surface disinfection, even in the most demanding indoor air conditions. This level of indoor air quality, disinfection, and decontamination is especially critical in healthcare and hospital settings. Each design we implement is meticulously engineered to delivering reliability and adherence to the strictest hygiene standards, ensuring a medical-grade quality of indoor air.

The S3 Trifecta approach that underpins our delivery of Medical Grade Indoor Air Quality comprises:

1. MONITORING

We have the capability to continuously monitor the air and diagnose it digitally in real-time, 24/7/365. This real-time monitoring ensures that any deviations from the desired indoor air quality are swiftly identified and addressed.

2. ACTIVE EDGE TECHNOLOGIES

Our solutions actively reduce the transmission of contaminants, pathogens and disinfect both air and surfaces within the space around the clock, 24/7/365. This proactive approach is crucial for maintaining a clean and safe indoor

3. PASSIVE EDGE TECHNOLOGIES

We incorporate passive edge technologies that effectively clean the air as it passes through the air handling (HVAC) system. This ensures that the air circulated throughout the indoor space remains consistently clean and free from harmful contaminants.

S3 employs indoor air quality sensors to actively and continuously monitor Indoor Air Quality (IAQ) in real-time. These sensors provide invaluable data that allows us to take immediate corrective actions when necessary. Additionally, our advanced filtration systems not only capture traditional particulate matter as small as PM2.5 but also filter particles down to an impressive size of 0.1 microns. This advanced filtration technology enhances the energy efficiency of the entire system.

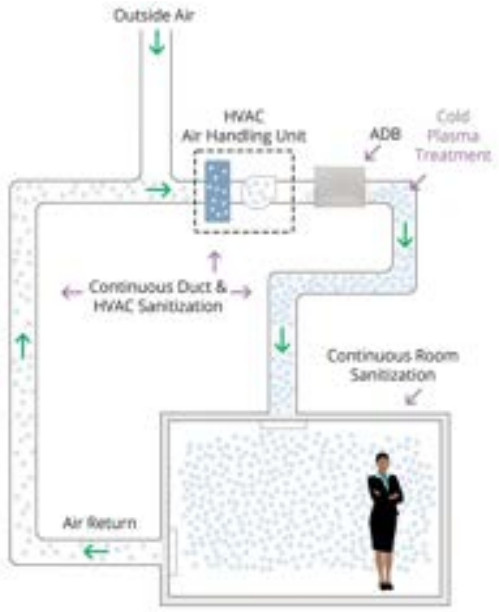
It's important to note that traditional approaches to achieving better filtration often have a negative impact on energy efficiency. This is primarily due to the increased pressure exerted on the system as a result of the enhanced filtration. However, S3's approach strikes a balance, ensuring both superior filtration and energy efficiency, ultimately delivering the highest standard of indoor air quality without compromising on environmental sustainability.

At S3, our commitment to innovation and excellence drives us to provide the best possible indoor air quality solutions while considering energy efficiency as an integral part of our approach. We are dedicated to ensuring the well-being and safety of occupants in various indoor environments, setting a new standard for indoor air quality and sustainability.

- ✔ **In-Duct Air**
- ✔ **Upper Air**
- ✔ **Ground Air**
- ✔ **Stagnant Air**

S3's comprehensive three-pronged approach is indispensable for ensuring the highest standard of healthy indoor air quality, which we proudly refer to as "Medical Grade Indoor Air Quality™." Our solutions have been meticulously designed and engineered to meet the exacting requirements and stringent standards of the healthcare and hospital industry, where the health and safety of individuals are paramount considerations.

A key pillar of our approach to delivering Medical Grade Indoor Air Quality is the utilization of non-thermal plasma (NTP), cold atmospheric plasma (CAP) or atmospheric cold plasma (ACP). These terms are often used interchangeably in research papers. The diagram provided illustrates how NTP, CAP or ACP technology, when integrated into ducted systems, can continuously, consistently, and universally enhance indoor air quality across a wide range of indoor environments.



Each project we undertake is tailored and application-engineered to maximize disinfection and decontamination, thereby reducing the transmission of infectious diseases. By synergistically employing these strategies, S3 establishes a robust defense against airborne threats, particularly viruses and bacteria. Each method complements the others, creating a formidable barrier that makes it exceedingly difficult for germs to survive and propagate.

S3 is enthusiastic to share the findings of two studies, conducted by esteemed institutions identified below, which substantiate the efficacy of our unique approach in delivering medical-grade indoor air quality across various indoor environments. These studies provide empirical evidence of the effectiveness of our solutions in enhancing indoor air quality and mitigating health risks, further affirming the value and reliability of S3's approach to indoor air quality management.

The first study (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9088580/ accepted 25 March 2022) and authored by members of the Department of Mechanical and Aerospace Engineering, University of California, Los Angeles, Los Angeles California, USA, Advanced Therapy Center, National Innovation Center for Advanced Medical Devices, Shenzhen People's Republic of China, Institute of Biomedical and Health Engineering, Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, Shenzhen People's Republic of China, Department of Pediatrics, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles California, USA, California NanoSystems Institute, University of California, Los Angeles, Los Angeles California, USA, Eli & Edythe Broad Center of Regenerative Medicine and Stem Cell Research, University of California, Los Angeles, Los Angeles California, USA, clearly states the important role of non-thermal plasma for meeting a pandemic such as the COVID-19 pandemic head-on. The study details how non-thermal plasma impacts microbial (pathogens) and fomites both in the air and on surfaces.

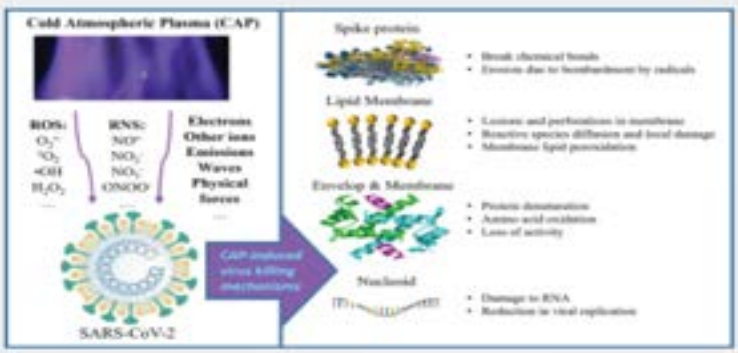
THE STUDY CONCLUDES

"CAP-based disinfection methods via direct application of CAP-activated media act by disrupting the integrity of the virus' vital structural and/or functional components and life cycle. These approaches offer several advantages over conventional sterilization methods for SARS-CoV-2. CAP-based technologies can be easily utilized and deployed during infectious disease crises, without requiring costly consumables that require robust and uninterrupted supply chains, or expensive and dangerous chemicals. Direct CAP application or CAP-activated media are able to safely and effectively disinfect a wide range of surfaces, including skin and medical PPE, while CAP discharges effectively decontaminate SARS-CoV2 bioaerosols.

As a potentially effective antiviral technology, CAP addresses several limitations of traditional antiviral and sterilization methodologies. For example, a drawback of UV-C irradiation is that it must be applied uniformly and directly on exposed surfaces with limited surface penetration and without diffusion and turning functions. Solutions that combine the fluidity of plasma could effectively solve this problem."

Abstract

The coronavirus disease 2019 (COVID-19) pandemic has greatly stressed the global community, exposing vulnerabilities in the supply chains for disinfection materials, personal protective equipment, and medical resources worldwide. Disinfection methods based on cold atmospheric plasma (CAP) technologies offer an intriguing solution to many of these challenges because they are easily deployable and do not require resource-constrained consumables or reagents needed for conventional decontamination practices. CAP technologies have shown great promise for a wide range of medical applications from wound healing and cancer treatment to sterilization methods to mitigate airborne and fomite transfer of viruses. This review engages the broader community of scientists and engineers that wish to help the medical community with the ongoing COVID-19 pandemic by establishing methods to utilize broadly applicable CAP technologies.



KEYWORDS

low temperature plasma (LTP), nonthermal plasma (NTP), plasma virus killing, SARS-CoV-2 plasma disinfection

KEY FIGURES IN THE REPORT

inactivation of bioaerosols and how CAP deactivates SARS-CoV2

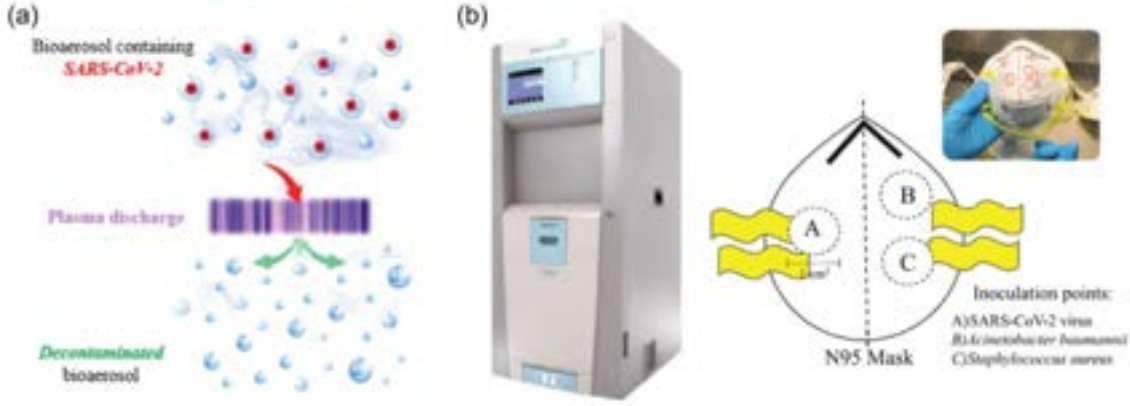
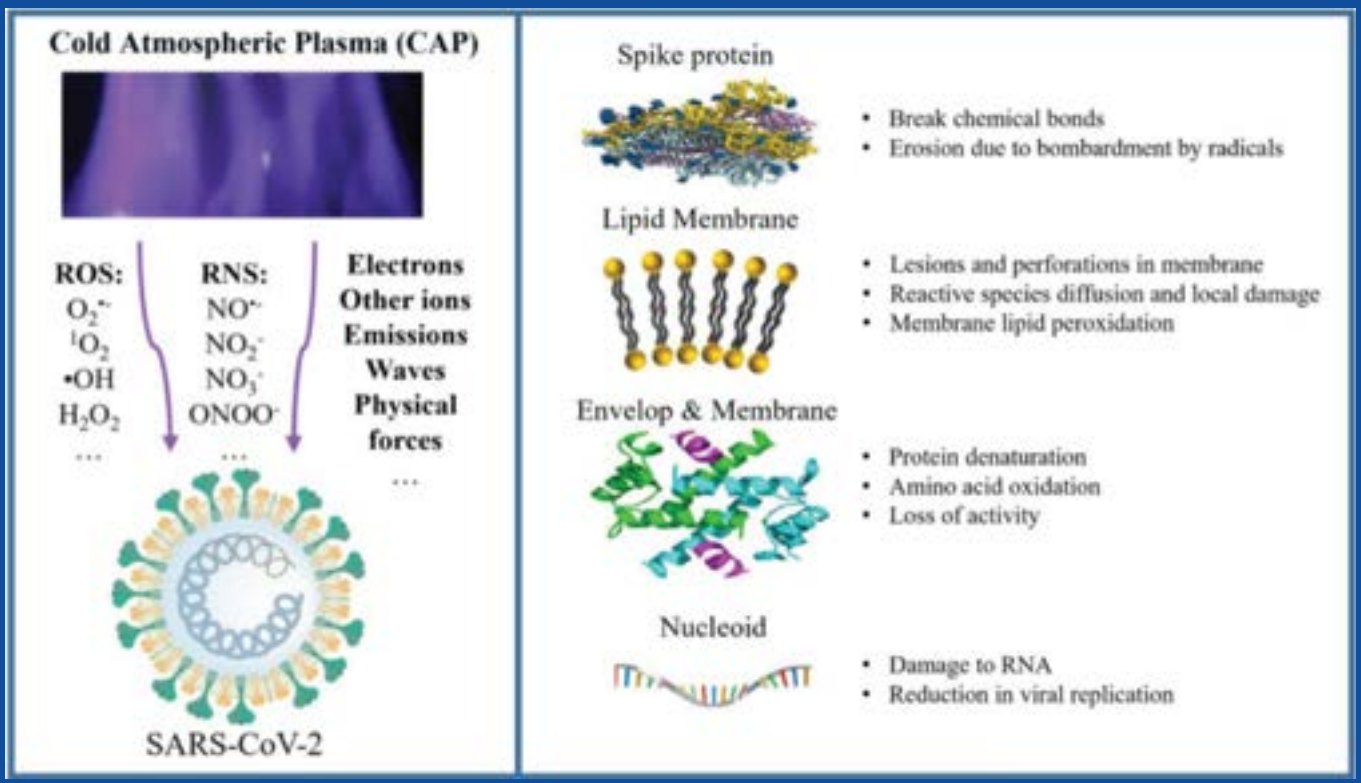


FIGURE 3 Gas plasma disinfection. (a) Dielectric barrier discharge plasma source is used to inactivate suitably produced bioaerosols containing *Staphylococcus epidermidis* or purified SARS-CoV-2 RNA. Reproduced from Reference [66]. (b) Disinfection of N95 masks artificially contaminated with SARS-CoV-2 and *Enterococcus faecium*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and *Enterobacter* (ESKAPE) bacterial species using hydrogen peroxide plasma. Reproduced from Reference [54]



The second study (https://www.frontiersin.org/articles/10.3389/fphy.2021.683118/full Published 01 June 2021) was completed by members of the following: Department of Microbiology and Immunology and Institute for Molecular Medicine and Infectious Disease, Drexel University College of Medicine, Philadelphia, PA, United States, Department of Mechanical Engineering, College of Science and Engineering, University of Minnesota, Minneapolis, MN, United States, Department of Chemistry, College of Arts and Sciences. This second study provides further evidence, both corroborating and expanding the importance of non-thermal plasma in treating and/or preventing viral infection and associated diseases.

The study concluded:

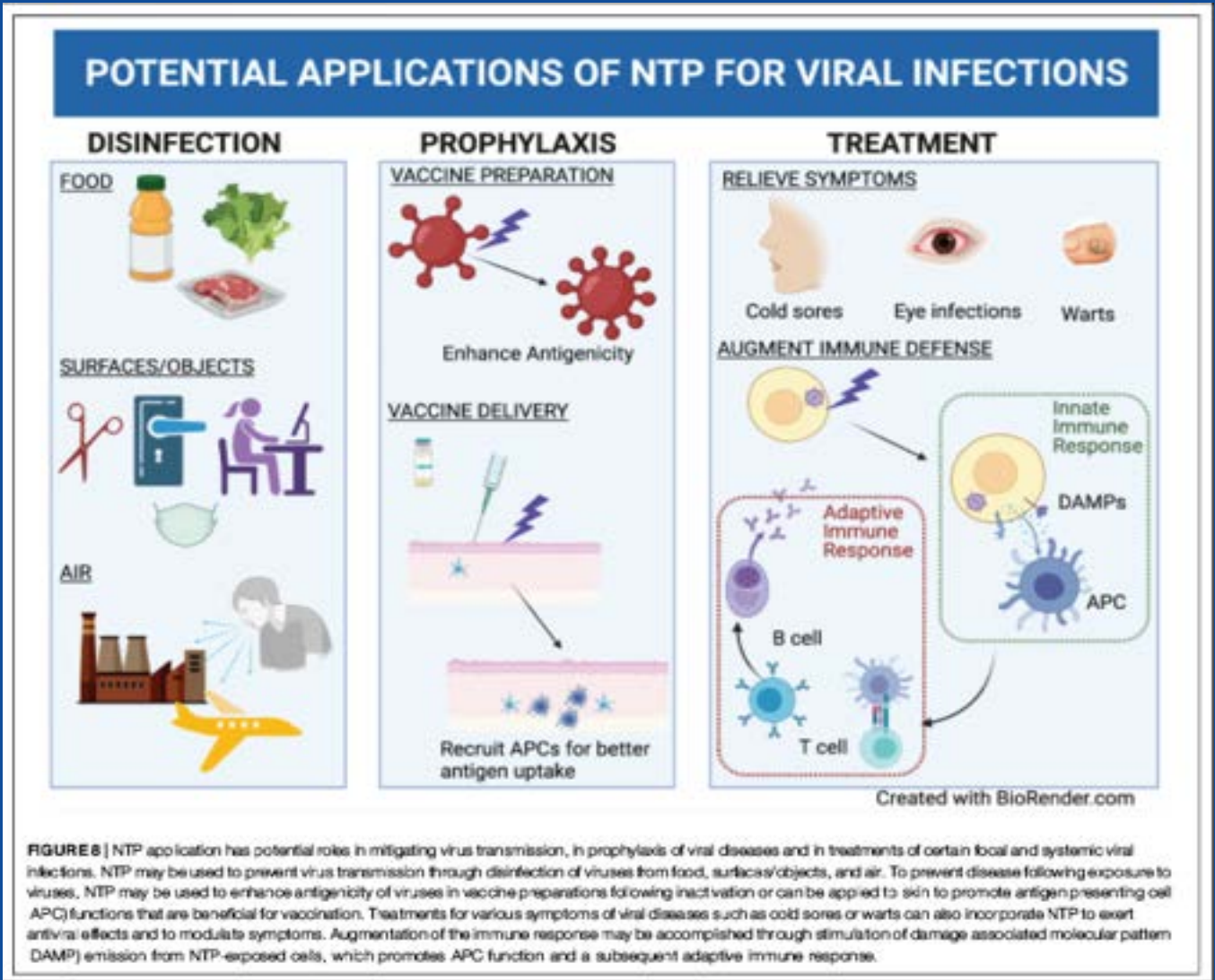


FIGURE 8 | NTP application has potential roles in mitigating virus transmission, in prophylaxis of viral diseases and in treatments of certain local and systemic viral infections. NTP may be used to prevent virus transmission through disinfection of viruses from food, surfaces/objects, and air. To prevent disease following exposure to viruses, NTP may be used to enhance antigenicity of viruses in vaccine preparations following inactivation or can be applied to skin to promote antigen presenting cell (APC) functions that are beneficial for vaccination. Treatments for various symptoms of viral diseases such as cold sores or warts can also incorporate NTP to exert antiviral effects and to modulate symptoms. Augmentation of the immune response may be accomplished through stimulation of damage associated molecular pattern (DAMP) emission from NTP-exposed cells, which promotes APC function and a subsequent adaptive immune response.

"Demonstrations of NTP-mediated virus inactivation have more recently been complemented by investigations of NTP as an antiviral agent that can be applied to prevent infection, interfere with virus replication, or indirectly impact viral infection and virus-associated disease by modifying host virus-specific immune responses. While the direct effects of NTP on virus infection and replication can be viewed as a derivation of the

use of NTP for surface decontamination, the use of NTP as a basis for immunotherapies against viral infections is a novel and intriguing advancement of biomedical applications for NTP."

KEY FIGURES IN THE REPORT

course of disease and immune response, key plasms species from NTP, and inactivation curves.

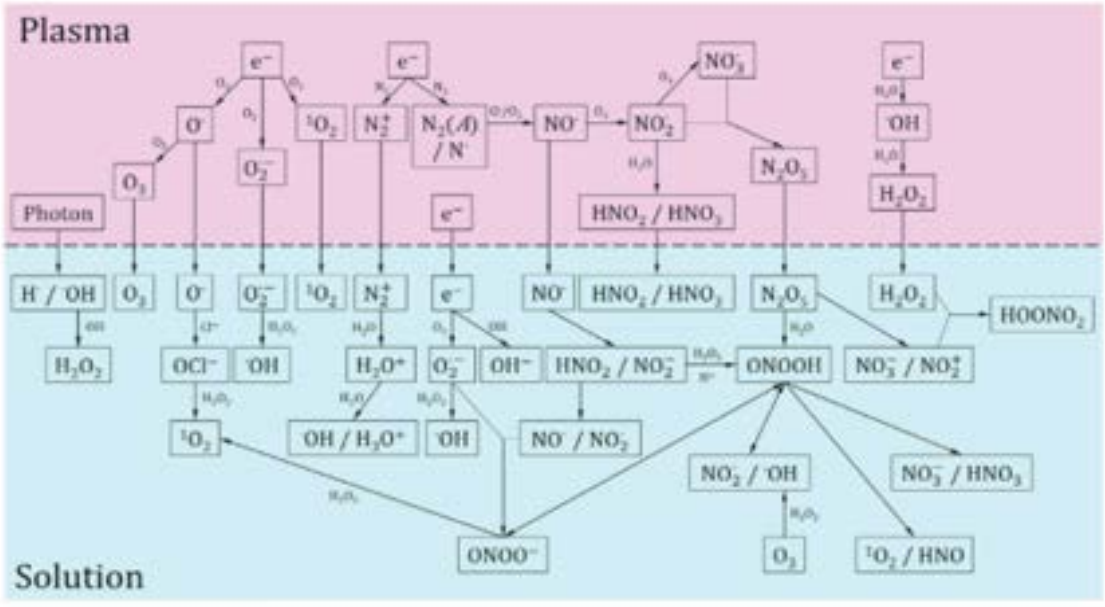


FIGURE 5 | Schematic of key plasma-produced species relevant to virus inactivation. Reaction pathways are also provided both in the gas phase and liquid phase. In the liquid phase, we also show the production of radicals from long-lived plasma produced chemistry. The horizontal dashed line represents the plasma-liquid interface. This set of reactions is a compilation of the reactions that are believed to be dominant for virus inactivation and is adapted from [59, 94, 184, 235, 239].

KEY PLASMA SPECIES PRODUCED BY S3'S AIR/SURFACE DISINFECTION NTP TECHNOLOGY

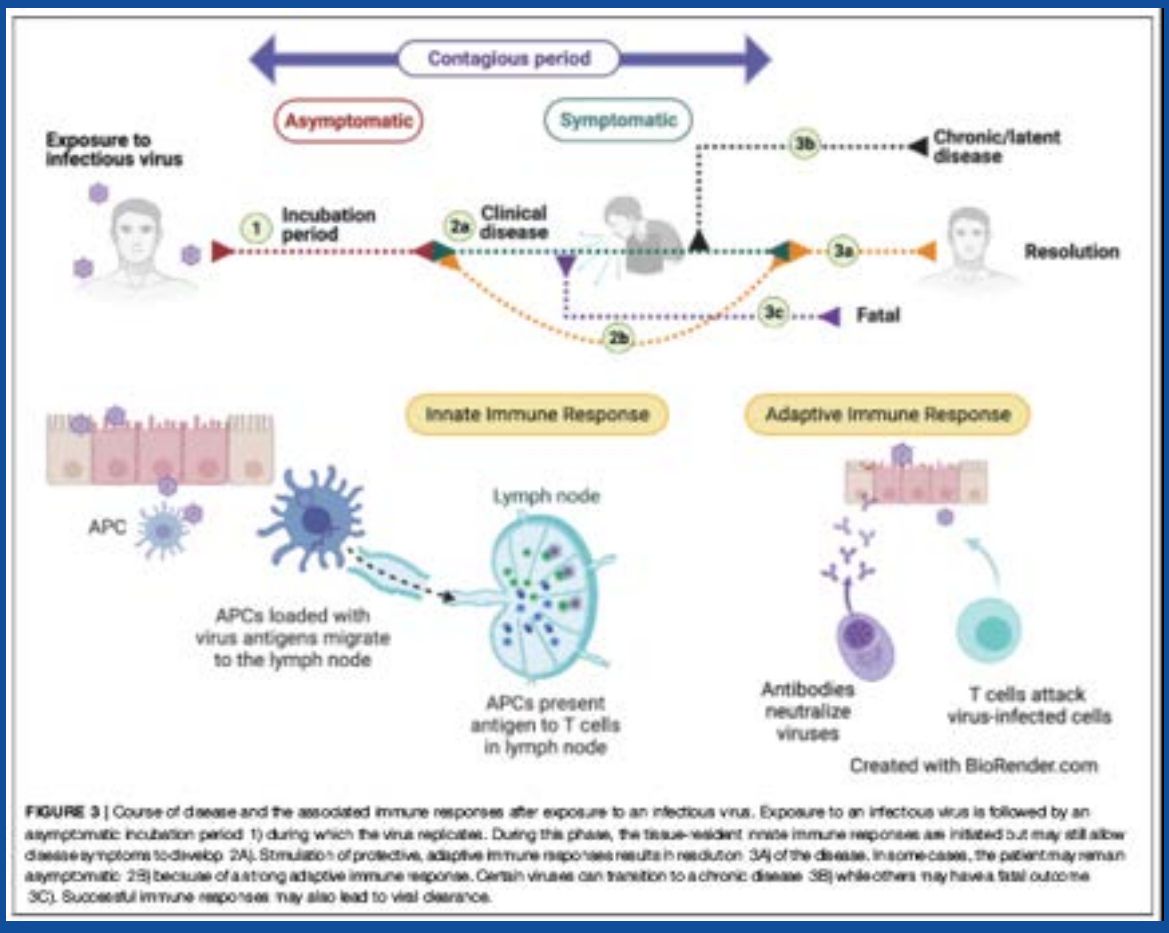


FIGURE 3 | Course of disease and the associated immune responses after exposure to an infectious virus. Exposure to an infectious virus is followed by an asymptomatic incubation period 1) during which the virus replicates. During this phase, the tissue-resident innate immune responses are initiated but may still allow disease symptoms to develop 2A). Stimulation of protective, adaptive immune responses results in resolution 3A) of the disease. In some cases, the patient may remain asymptomatic 2B) because of a strong adaptive immune response. Certain viruses can transition to a chronic disease 3B) while others may have a fatal outcome 3C). Successful immune responses may also lead to viral clearance.

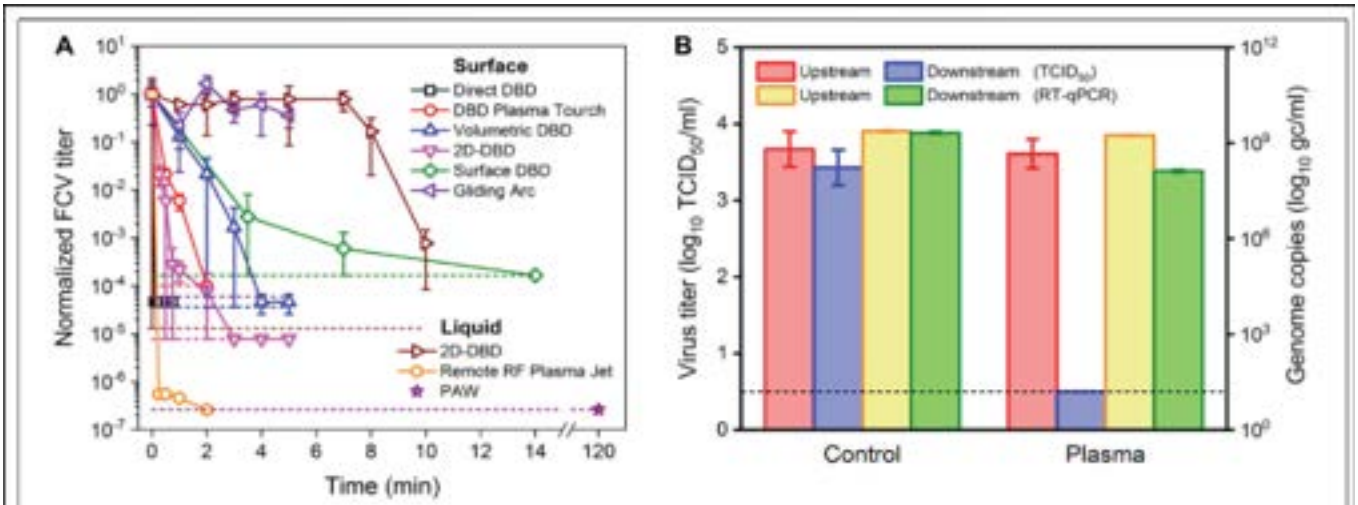


FIGURE 7 | A) Inactivation curves for FCV treated on surfaces and in liquid solution by different plasma sources and configuration shown in **Figure 6**. The data are taken from [87, 94, 95, 101, 102] and are normalized to the reference virus titer. The short dashed colored lines represent the detection limit for each of the corresponding plasma treatment. Note that the plasma power was 14.5 W for volumetric DBD, 2D-DBD and gliding arc, while a lower power was used for direct DBD 12 W), surface DBD 0.7 W) and RF plasma jet 2.5 W). The treatment of liquids is solution and volume dependent. In this case, the solution was distilled water and the volume was kept constant at 100 L. **B)** Schematic representation of the inactivation of aerosolized PRRS virus by a volumetric DBD treatment in wind tunnel test conditions at sampling time of 5 min and discharge power of 39.8 W. The graph compares the amount of infectious virus before control) and after plasma) treatment as obtained by the $TCID_{50}$ approach with a measure of the remaining genome obtained with the RT-qPCR method. The results show a reduction of 3.5 log_{10} remaining infectivity is below detection limit), while the genome remains, confirming that the majority of the inactivated virus is still collected downstream of the plasma treatment [115].

INACTIVATION CURVES FOR S3'S AIR/SURFACE DISINFECTION NTP TECHNOLOGY

Our dedication to delivering Medical Grade Indoor Air Quality™ has led us to conduct an exhaustive examination of every facet of HVAC systems and the essential building mechanics related to air handling systems. Our objective has been to identify and implement the most effective, efficient, and cost-effective methods to achieve this exceptional standard of indoor air quality.

A TECHNOLOGY PARADIGM

S3 presents revolutionary solutions through our cutting-edge Net Zero Energy/Indoor Air Quality standards program. Our state-of-the-art systems are carefully designed to provide our clients with the highest possible standard of medical-grade indoor air quality while achieving significant energy efficiency.

This visionary approach has captured the attention of building owners and management groups and stands as a trailblazing method for shaping the future of architectural engineering.

We invite you to join the ranks of those who recognize the limitless potential of our solutions and embark on a journey toward building excellence like never before.

Choose S3 to lead your projects towards a healthier, safer, and more sustainable future.

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310-991-9798

www.sterilesafesolutions.com

info@.sterilesafesolutions.com

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