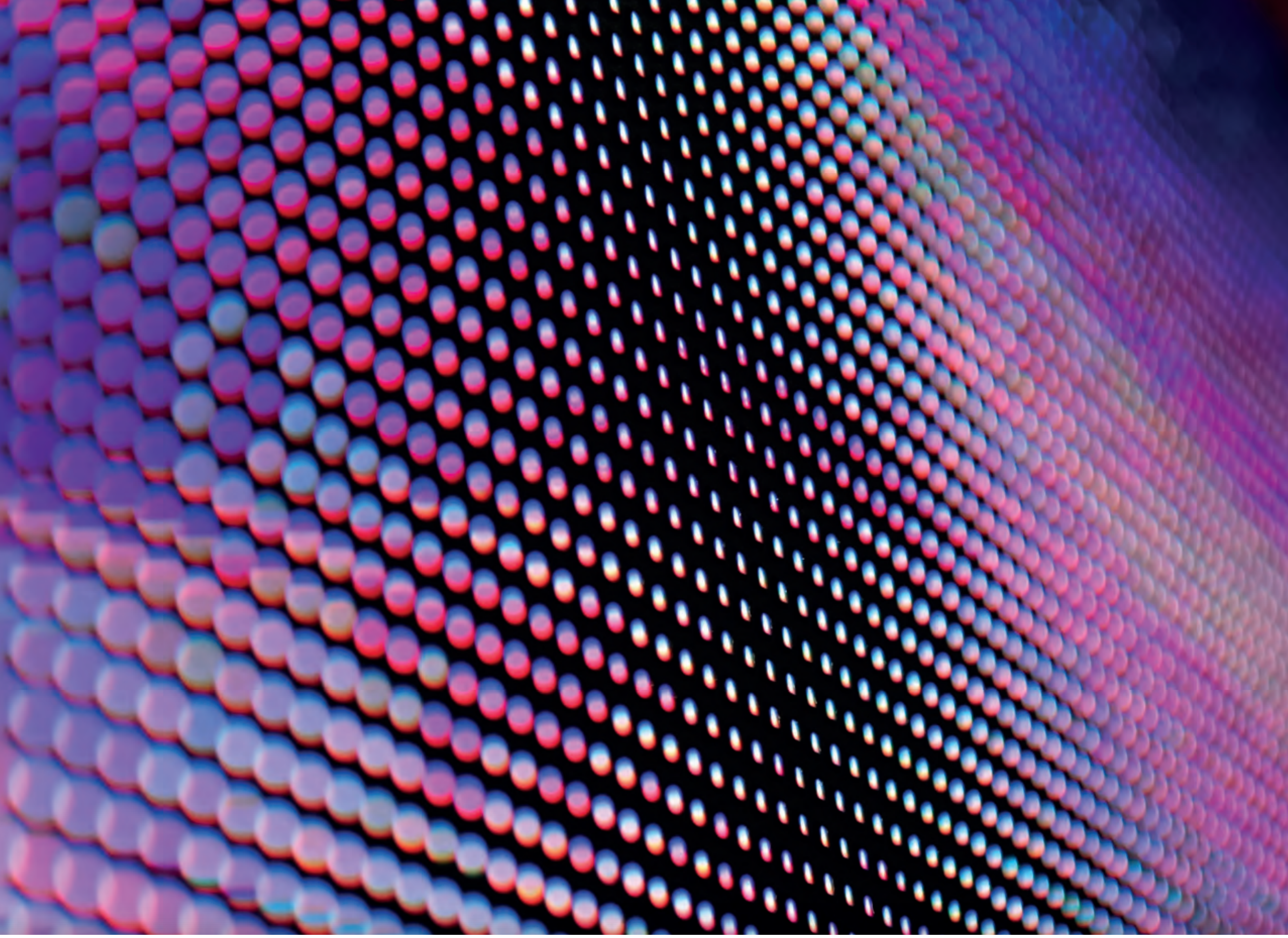


U PROTECT
THE POWER OF SUSTAINABLE DISINFECTION

Using far-UVC 222nm light to significantly reduce pathogens like SARS-CoV-2 (COVID-19) in indoor spaces

Disease-causing bacteria and viruses threaten the lives of millions of people each year. Since the start of the pandemic, millions have become infected and more than 1 million people worldwide have died. And these numbers continue to increase as many countries move into second and even third waves of infection.

History shows us that it's only a matter of time before the next novel pathogen threatens our lives and livelihoods. We need ongoing solutions to defend ourselves from pathogens to reduce their incredible impact on our families, businesses, schools, and communities.

We need safe and effective technology for indoor public spaces where people gather—from airports, schools, and public transportation to all forms of entertainment venues—that can effectively reduce pathogens.

Could ultraviolet light be an effective solution?

Recent studies point to ultraviolet (UV) light technology as an important potential solution for reducing pathogens in indoor spaces. We know UVC light can reduce pathogens, but traditional germicidal lamps have a peak emission of 254nm that represents a human health hazard that can penetrate our skin and eyes, so cannot be used where unprotected people are present. These shortcomings constrain how these devices must be operated and limit their widespread use in occupied indoor spaces.

Is far-UVC 222nm light the answer?

Promising new studies show that shorter UVC wavelengths—with the sweet spot being 222nm—have the unique ability to significantly reduce pathogens and may also be used around people.

This white paper examines how shorter wave, far-UVC 222nm light—paired with a short pass filter that prevents longer wavelengths from being emitted—can effectively reduce pathogens like the SARS-CoV-2 coronavirus that causes COVID-19 as well as harmful bacteria, influenza, and even antibiotic-resistant superbugs like MRSA, and may also be used around people.

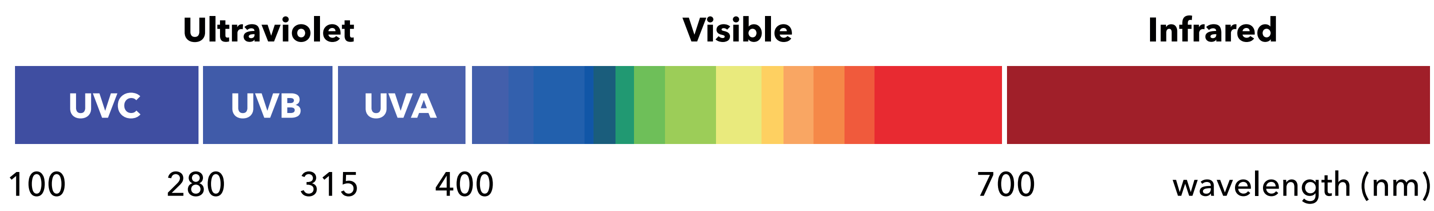
Let's start with a quick look at UV light.

UVA, UVB, and UVC: What's the difference?

UV light is made up of 3 bands: UVA, UVB and UVC. Around 95% of the sun's rays that reach the ground are UVA rays. They have the longest wavelengths (315nm-400nm) and can damage our skin, causing premature aging such as wrinkles and are thought to play a role in some skin cancers. UVB rays (280nm-315nm) make up around 5% of the sun's rays, and while they don't penetrate our skin as deeply as UVA, they can cause significant damage to our skin, including redness, sunburn, and skin cancer. We use sunscreen and wear sunglasses to protect our eyes and skin from both UVA and UVB rays.

Most UVC rays (100nm-280nm) don't reach the earth's surface because they're absorbed by the ozone layer. UVC has the shortest wavelengths that, at ranges below 230nm, aren't able to penetrate beyond the top layer of our skin or eyes.

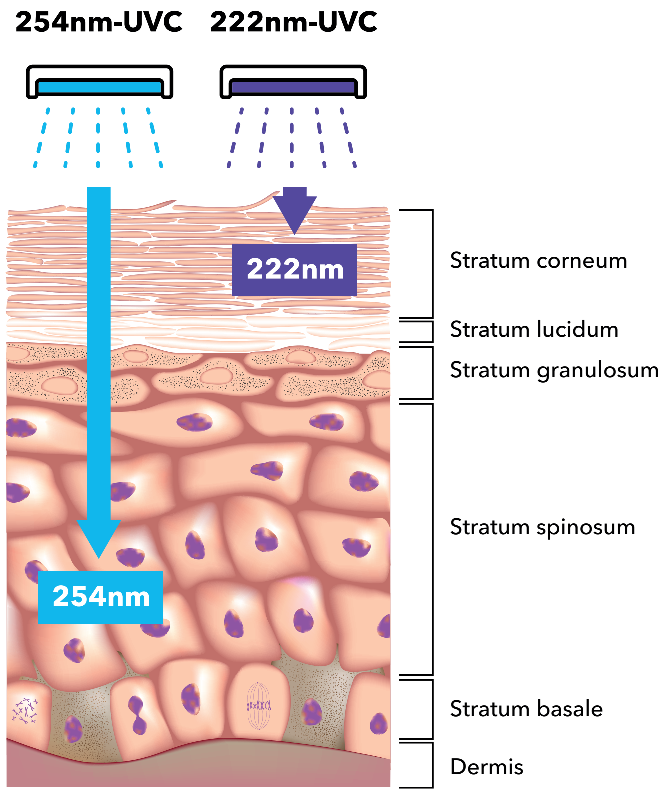
The spectrum of visible and invisible light



This graphic illustrates the 3 types of ultraviolet light the sun produces: UVA, UVB, and UVC.

Structure of the epidermis

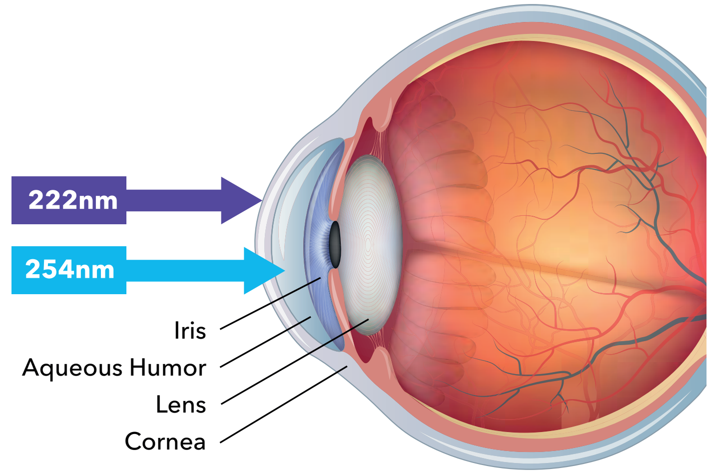
Penetration of epidermis of 254nm vs 222nm



This graphic illustrates a significant difference between 254nm and 222nm light: the shorter wavelengths of far-UVC 222nm light have a limited ability to penetrate past the outer layer of our skin. This layer, the stratum corneum, consists of dead skin cells and serves as the primary barrier between our bodies and the environment. Conversely, longer wavelengths like 254nm are able to deeply penetrate the layers of our skin, and can damage the DNA in our skin cells, causing burns and skin cancers.

Anatomy of the eye

DNA absorbance relative to wavelength



This graphic clearly illustrates how 254nm (and longer) wavelengths are able to damage our eyes—including incurable diseases like macular degeneration—because wavelengths of 230nm and above can penetrate our eyes. Shorter wavelength 222nm light has a limited range that prevents it from penetrating past our corneas, the outermost layer of our eyes.

Shorter UVC wavelengths yield effective results

Instrumental in spearheading the use of far-UVC light to fight the spread of viruses and combat antibiotic-resistant bacteria: Dr. David J. Brenner, Ph.D., D.Sc., a theoretical physicist and Higgins Professor of Radiation Biophysics, College of Physicians & Surgeons, Columbia University. His mission is to find mathematical and physics-related solutions to biological problems. In his pivotal April 2017 TED Talk, Dr. Brenner shares his research on how far-UVC could potentially kill superbugs and be used around people.

The physics of far-UVC 222nm light: Studies, safety, and efficacy

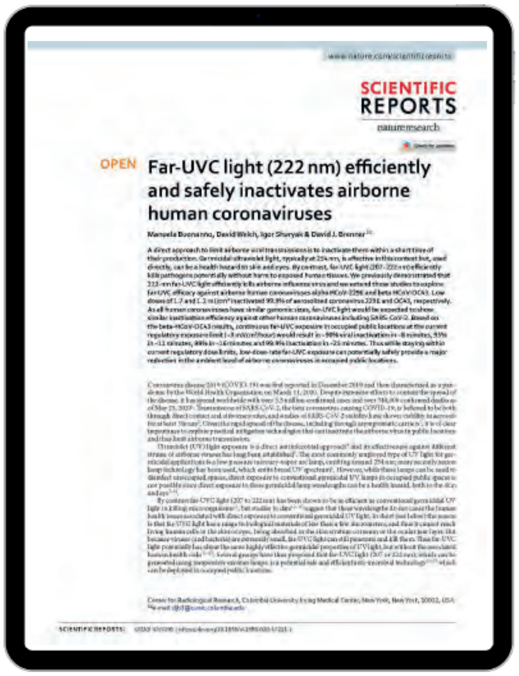
Dr. David J. Brenner, Ph.D., D.Sc.
Theoretical physicist
Higgins Professor of Radiation Biophysics
College of Physicians & Surgeons
Columbia University

COVID-19 Virtual Symposium: April 8, 2020
(Video length – 11:23)

Watch the video »

Is far-UVC 222nm light effective against airborne coronaviruses?

In a peer-reviewed study entitled Far-UVC light (222nm) efficiently and safely inactivates airborne human coronaviruses published in June 2020 in the journal Nature, researchers at Columbia University Irving Medical Center reported that **99.9%** of aerosolized seasonal coronaviruses (that cause the common cold) were inactivated when exposed to far-UVC 222nm light for 25 minutes.


SCIENTIFIC REPORTS

OPEN Far-UVC light (222 nm) efficiently and safely inactivates airborne human coronaviruses

Manuela Buonanno, David Welch, Igor Shuryak & David J. Brenner

This study found:

1. Even with very low exposure (1.7 and 1.2 mJ/cm^2) to far-UVC light, more than 99.9% of coronaviruses present in airborne droplets were neutralized, meaning they could no longer reproduce or cause infection
2. Continuous exposure to far-UVC 222nm light at the current regulatory limit (~3 mJ/cm^2/hour) eradicated airborne viruses in minutes:
   - 8 minutes – 90%
   - 11 minutes – 95%
   - 16 minutes – 99%
   - 25 minutes – 99.9%

Is far-UVC 222nm light safe for humans?

A study conducted by Kobe University researchers called Exploratory clinical trial on the safety and bactericidal effect of 222-nm ultraviolet C irradiation in healthy humans published in August 2020 in PLOS ONE suggests that the filtered far-UVC light can be used to reduce pathogens while people are present.


PLOS ONE

RESEARCH ARTICLE

Exploratory clinical trial on the safety and bactericidal effect of 222-nm ultraviolet C irradiation in healthy humans

Abstract

Introduction

Methods

Results

The study irradiated the backs of 20 healthy volunteers with far-UVC 222nm light at 50–500 mJ/cm^2 and evaluated the induced erythema (skin redness).

This study found:

1. Far-UVC 222nm light didn't cause any erythema on study participants at even high doses (up to 500 mJ/cm^2)
2. The bacterial colonies in the skin swab cultures were significantly lowered by far-UVC 222nm irradiation

Can far-UVC 222nm light inactivate SARS-CoV-2?

A study published in September 2020 in the American Journal of Infection Control by researchers at Hiroshima University entitled [Effectiveness of 222-nm ultraviolet light on disinfecting SARS-CoV-2 surface contamination] found that far-UVC 222nm light effectively reduced **more than 99.7%** of surface contamination of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), the virus that causes COVID-19.


ARTICLE IN PRESS

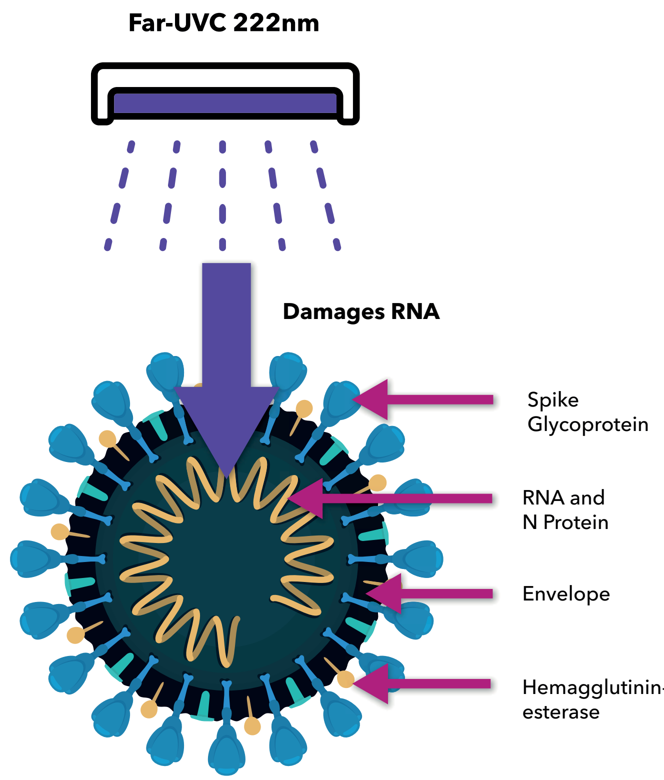
American Journal of Infection Control

Major Article

Effectiveness of 222-nm ultraviolet light on disinfecting SARS-CoV-2 surface contamination

How does far-UVC 222nm light inactivate viruses?

Far-UVC 222nm light inactivates pathogens like coronaviruses by damaging their RNA, which effectively neutralizes them since they are unable to reproduce in our bodies or spread to cause new infections.



SARS-CoV-2 coronavirus. This graphic illustrates how far-UVC 222nm light penetrates and inactivates coronaviruses like SARS-CoV-2 (COVID-19) by damaging its RNA

Technology backed by research

- In February 2017, researchers at Columbia University Irving Medical Center published a paper in the National Center for Biotechnology Information (NCBI), U.S. National Library of Medicine called [Germicidal Efficacy and Mammalian Skin Safety of 222-nm UV Light]that shows far-UVC 222nm light is as effective at killing (antibiotic-resistant) bacteria as conventional germicidal UV lamps that use 254nm light, but without associated skin damage risks.
- A paper published in May 2020 in the National Center for Biotechnology Information (NCBI), U.S. National Library of Medicine entitled [Long-term Effects of 222-nm ultraviolet radiation C Sterilizing Lamps on Mice Susceptible to Ultraviolet Radiation]by researchers at Kobe University investigated the long-term effects of far-UVC 222nm light on skin using highly photo-carcinogenic phenotype mice. The results suggest that far-UVC 222nm lamps can be used as an alternative to 254nm, since 222nm exerts a comparable disinfection ability but can be safely used for sterilizing human skin.

Far-Uvc 222nm

Far-UVC 222nm light, like has shown in the lab, is capeable to inactivate **more than 99%** of surface pathogens—including SARS-CoV-2 (COVID-19), influenza, bacteria and antibiotic-resistant superbugs. Far-UVC 222nm light is the only UVC technology shown to be effective in reducing reducing pathogens that may also be used around people.

Top 3 reasons to choose Far-Uvc

1. Can be used when people are present
The far-UVC technology emit far-UVC 222nm light that cannot penetrate healthy human skin when used in accordance with operational specifications

2. It's effective
The far-UVC light can reduce surface pathogens—including coronaviruses like the common cold and SARS-CoV-2, nfluenza, and bacteria

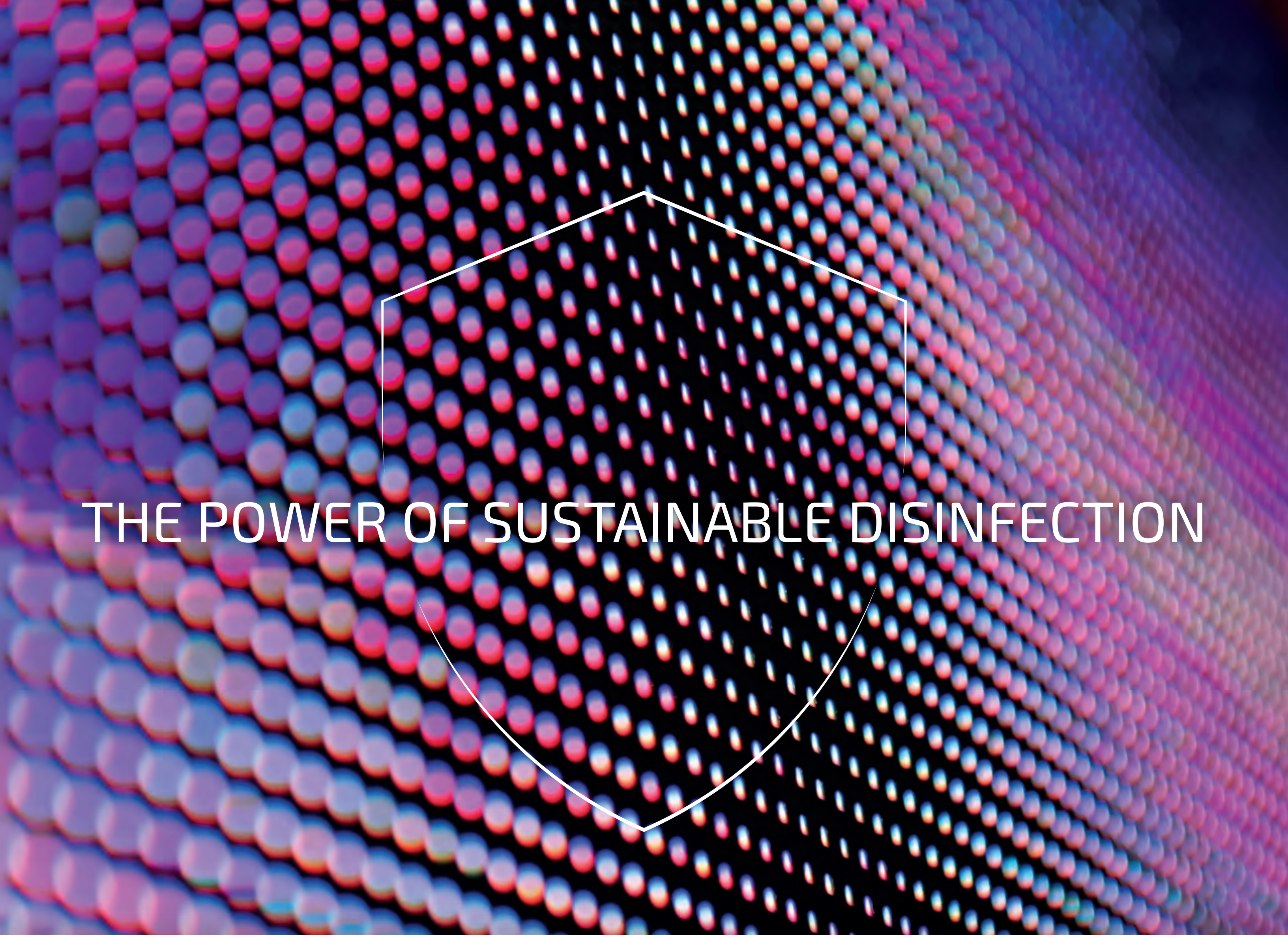
3. It's an added layer of defense
Far-UVC 222nm light damages the RNA of pathogens like coronaviruses provide an added layer of defense when used in combination with other measures like washing hands

Far-Uvc lamps

- Easy-to-use – As easy to install as traditional commercial lighting fixtures
- Instant on/off at full output power
- Frequent on/off cycles don't affect lamp life
- Able to operate over a wide range of ambient temperatures
- Remote monitorable for easy programming and troubleshooting
- Easy-to-service for straightforward lamp changes
- Fixtures are available in black or white to fit existing color schemes
- Available in both AC and DC power configurations

Now there's a way to reduce pathogens like coronaviruses

Put Far-UVC to work to significantly reduce surface pathoge ns in your venue today.



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For information: **info@u-protect.it**