Medical Xpress

Study shows personal disinfection device safe for use in public spaces

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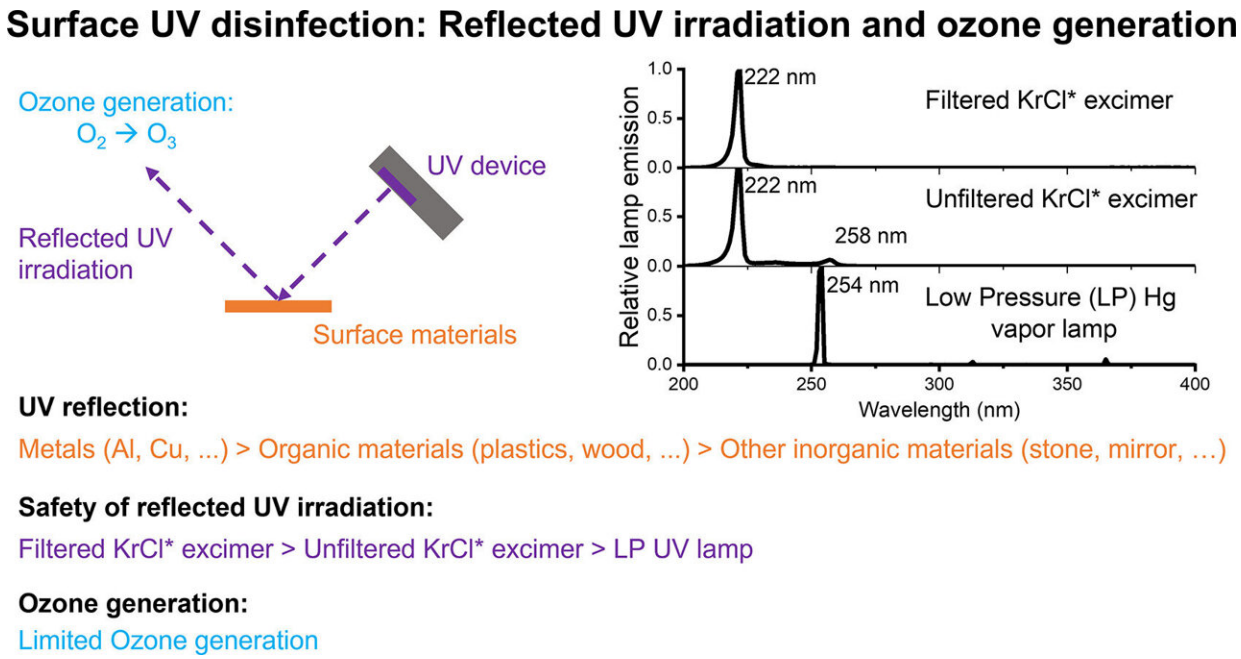

Graphical abstract. Credit: *Science of The Total Environment* (2023). DOI: 10.1016/j.scitotenv.2023.161848

Imagine pointing a small device at your movie seat or restaurant table to kill harmful bacteria or viruses with a disinfecting light.

The disinfecting properties of UV light have long been known, along with the dangers of human exposure to it. Now a new Linden Research Group study recently published in the journal *Science of the Total*

Environment confirms the safety of a new portable, handheld disinfecting device using a technology called Far UV-C. The device is safe for use without protective gear on the skin or eyes.

Ben Ma, a postdoctoral researcher in environmental engineering, was the first author on the paper. The study examined the reflectivity of UV rays emitted from the device on various common materials and compared it to the conventional mercury-based UV-C devices.

The study demonstrated that, unlike the conventional UV devices emitting at 254 nm, the new handheld device, which emits Far UV-C rays at 222 nm, does not generate harmful amounts of reflected UV light for the user or nearby people and is safe to be used as a personal surface disinfecting device in hospital or health care settings, while traveling or at a restaurant or gym.

We asked Ma to share more on this study, as well as his experiences as a postdoctoral researcher at CU Boulder.

Do you foresee people having their own personal device, and when they go to, let's say, a movie theater, they disinfect their seat?

That's basically the idea. We're working with a startup company (Freestyle Partners, LLC) which already has a prototype—a handheld UV device with a battery. Using this device on a surface can kill pathogens like SARS-CoV-2 by 99.9% within a couple of seconds. So it's very effective, and it's very safe.

Can you tell us a little about this paper and its impact?

The paper's focus is to evaluate and determine the intensity of the reflective radiation from this surface disinfection device. So, if the surface reflects UV radiation, the radiation could bounce back to the person holding it and possibly to people in the surrounding area. The reason we study reflection is because UV radiation can be detrimental to human health, and when you use a UV device for surface disinfection, most likely the exposure is not from the device, but from the reflection.

In this study we tested 21 materials commonly found in public spaces. We studied different materials because different materials have different reflectivity. So, for example, metals tend to have a greater reflectivity than plastics.

Why is this emerging technology safer?

Germicidal radiation has wavelengths between 200 to 280 nanometers. One of the emerging technologies that we are very interested in is the Far UV-C portable handheld device, which emits primarily at 222 nanometers; 222 nanometer UV radiation is much safer for humans compared to 254 nanometers emitted from the conventional mercury-based devices, which are known to be hazardous upon exposure to human skin and eyes.

222 nanometer UV radiation can effectively inactivate all kinds of pathogens but has very poor cellular penetration. It can be blocked by the very top layers of human skin and eyes, whereas 254 nanometer radiation can penetrate through that layer and get to the germinative cells, resulting in adverse health effects. Our study showed that for eye exposure the emerging Far UV-C device is 23 times safer compared to traditional UV and, for skin exposure, 43 times safer.

We also calculated the maximum exposure time, and we found that even considering the worst-case scenario, in most cases the emerging

technology is safe to use for surface disinfection for more than eight hours per day.

Scientists say COVID exposure is mostly aerosol and not due to surface contamination. So why is this an important disinfection tool?

I agree that COVID exposure is mainly through aerosol, but surfaces are still a source of SARS-CoV-2 transmission, and COVID as well as other pathogens of concern can be viable on a surface for up to several days. Without disinfection, it will be viable for transmission. Also, there are studies demonstrating that this emerging Far UV-C technology can also be used for aerosol disinfection in occupied public spaces, such as elevators, restaurants and hospitals.

So looking to the future, could the paper have a pretty big impact?

Overall we hope this amazing technology will be used to help reduce the effects of the pandemic and future public health events.

Right now we mainly focus on SARS-CoV-2. But in the real world we encounter pathogens every day, everywhere. So, for example, this device could also be used in kitchens to disinfect pathogens on food, cutting boards and cookwares. If you camp or hike, we actually have a commercialized product using UV to disinfect the water from a creek.

What's the next step on this research project?

In terms of evaluating reflection and safety of these kinds of sources, our work will support further industry development of UV applications. We

are continuing to research these and other UV wavelengths for public health protection in air, water and surfaces.

Our group is working on another study to standardize the testing method to evaluate the surface disinfection performance of UV radiation. Right now we don't have standardized methods to evaluate the effectiveness of a UV disinfection device. The study could provide essential guidance on employing this technology into the real world to help control not just the current pandemic, but maybe future pandemics or any pathogens that we encounter.

More information: Ben Ma et al, Reflection of UVC wavelengths from common materials during surface UV disinfection: Assessment of human UV exposure and ozone generation, *Science of The Total Environment* (2023). DOI: 10.1016/j.scitotenv.2023.161848

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