April 7, 2022

Citizen Electronics Co., Ltd.

Development of high-power deep ultraviolet (UVC) LED assembly product Confirmation that the product achieves a 99.99% rate of inactivity of the COVID-19 virus

Citizen Electronics Co., Ltd. (Head office: Fujiyoshida-City, Yamanashi Prefecture. President: Sekiguchi Kanetaka) has developed a "High-power UVC LED assembly product for disinfection (hereinafter called "UVC LED Assembly Product"). The product uses a high-power deep ultraviolet (UVC) LED that has a 265nm emission wavelength, which is assumed to have a high germicidal effect. Mass production is scheduled to start from the middle of April 2022.

Lineup of High-power UVC LED Assembly Products

		
Product name	UVM001	UVM003 (6-light type)
Size	W42×L27×H10mm	W200×L30×H43.5mm
Light distribution angle	Narrow / Middle / Wide	Narrow / Middle
Front central illuminance *1	0.115mW/㎠	0.027mW/㎠

* Reference values of middle angle, rated drive and distance of 10 cm (UVM001) and 50 cm (UVM003)

With the spread of COVID-19 virus, demand for disinfection has been increasing. We have developed an assembly product that produces 265 nm high-power deep ultraviolet (UVC) light, which can be used for surface disinfection and air disinfection, for inhibition of SARS-CoV-2 infection and also for water disinfection ensuring a safe water supply. The UVC LED has a lineup of a single-light type and six-light types, which enable various applications. It is already adopted for air-conditioning systems for professional use and air purifiers.

Characteristics

1. With a high-reflection reflector, the product achieves uniform illuminance so effective disinfection is possible
2. Adopts a high-power UVC LED with 265 nm wavelength which has a high germicidal effect
3. A high-power assembly product enabling replacement with germicidal lamps, which are problematic as they contain mercury
4. Being dustproof and waterproof (equivalent to IP54), it can be used under various conditions *UVM001

We have collaborated with Fujita Health University (School of Medicine, Associate Professor Kawamoto of Virology and Parasitology) to verify an inactivation effect on SARS-CoV-2 through use of not our single UVC LED, but our UVC LED assembly, also confirming its high inactivation effect (Test 1).

Through use of our mounting technology and optical technology that were created during our history of developing LEDs, our UVC LED assembly product, which has a 265nm wavelength with a high germicidal effect and an appropriate light distribution for the target, was confirmed to have an inactivation effect of 99.9% against viruses over a wide area after only 10 seconds and 99.99% after 20 seconds when lit from a height of 5 cm. With these properties, downsizing of the device is realized and disinfection of a wide area in a short time is achieved. In addition, as we have confirmed that the required irradiation dose for inactivation is 4.73mJ/ $cm^{2,}$ customers can adjust the irradiation dose, which is indispensable in the design of a disinfection device, in accordance with the purpose.

This UVC LED assembly product has a high-power UVC LED with peak wavelength 265 nm. We have conducted a test to compare the inactivation effect by replacing the LED of the assembly product with an LED having 275 nm peak wavelength. As a result, it was confirmed that the LED with 265 nm peak wavelength, which is used by our UVC LED assembly, can achieve an inactivation effect against viruses in a shorter time (about half) (Test 2).

Summary of the test on the inactivation effect on SARS-CoV-2

Test 1: Test on the inactivation effect on SARS-CoV-2

Summary and results of the test

Method : UVC light is lit from the height of 5 cm/15 cm and the time required for inactivation is measured by TCID50 measuring method.

UVC illuminance for 5 cm/15 cm was 0.4730mw/ cm2 and 0.0518 mw/ cm^2 each.

Results: From the height of 5 cm, inactivation of 99.9% after 10 seconds, and inactivation of 99.99% after 20 seconds was confirmed.

From the height of 15 cm, inactivation of 99.9% after 100 seconds, and inactivation of 99.99% after 200 seconds was confirmed.

The irradiation dose required for inactivation of 99.9% was 4.73mJ/cm^2.

The irradiation dose required for 99.99% was 9.46mJ/cm^2.

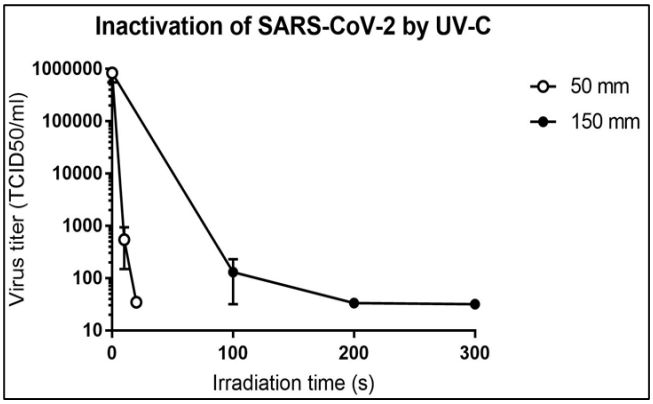


Fig.1 Test results for infection ratio of virus

	99.9%	99.99%
5 cm	10 sec.	20 sec.
15 cm	100 sec.	200 sec.

Table 1: Time for inactivation at each distance by UVM001

	99.9%	99.99%
Irradiation dose for inactivation	4.73mJ/cm^2	9.46mJ/cm^2

Table 2 Irradiation dose required for inactivation

Test 2: Inactivation test against SARS-COV-2 by using two LEDs with different peak wavelengths

Summary and results of the test

Method: UVC light of 265 nm and 275 nm each is lit from the height of 20 cm and the time required for inactivation is measured by TCID50 measuring method. Drive conditions were adjusted in order to achieve UVC illuminance of 0.025mw/ cm2 for both LEDs.

Results: As for 265 nm, from the height of 20 cm, inactivation of 99.9% after 300 seconds was confirmed. The irradiation dose required was 7.5mJ/cm2.

As for 275 nm, from the height of 20 cm, inactivation of 99.99% after 600 seconds was confirmed. The irradiation dose required was 15.0mJ/cm2.

From the above results, it was confirmed that LED with 265 nm peak wavelength, which is used for our product, is able to achieve an inactivation effect in a shorter time (about half).

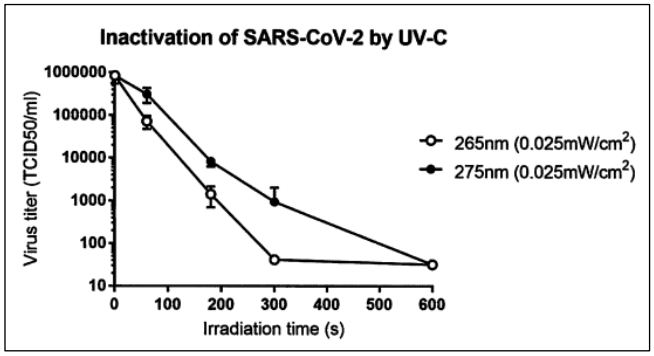


Fig.2 Test results for infection of virus

	265nm	275nm
Inactivation of 99.99%	300 sec.	600 sec.
Irradiation dose	7.5mJ/cm²	15.0mJ/cm²

Fig.3 Time and irradiation dose required for inactivation from the height of 20 cm

Cells infected with virus that were not irradiated with ultraviolet rays

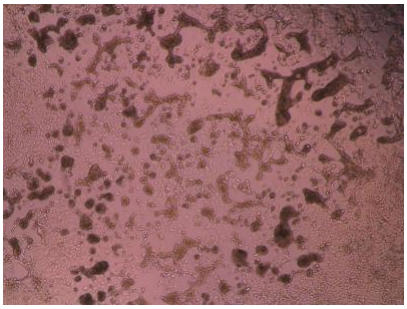


Fig.3 Severe cellular cytotoxicity was confirmed

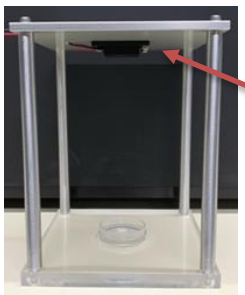
Cells infected with virus that were irradiated with ultraviolet rays

Fig.4 No cellular cytotoxicity was confirmed. It means that the virus was inactivated

Photos of test

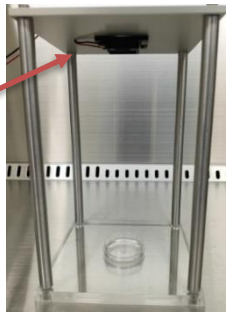
Irradiation test from the height of 5 cm

Irradiation test from the height of 15 cm



UVC assembly product : UVM001

Irradiation test from the height of 20 cm



* Fujita Health University 藤田医科大学

Fujita Health University is actively working on research and development targeting SARS-CoV-2. At the time of the spread of the infection on the passenger ship Diamond Princess in 2020, the university admitted infected patients and provided medical institutions in Japan with information about pioneering cases useful in preventing the spread of the infection. The cases were called “the Fujita Model.”

Supplementary material

Test 3

Summary and results of the test

Method: Illuminance of UVC light with 265 nm wavelength was adjusted to a lower degree, 0.016 W/c ㎡. Then, UVC light is lit from the height of 20 cm and the time required for I inactivation is measured by TCID50 measuring method

Results: Inactivation of 99.99 % after 600 seconds was confirmed. The irradiation dose required was 9.6 mJ/cm^2.It was confirmed that with 265 nm wavelength, even by illuminance of 0.016mW/ cm,^{2} inactivation effect equivalent to that of 0.025mW/c ㎡ in Test 2 is achieved.

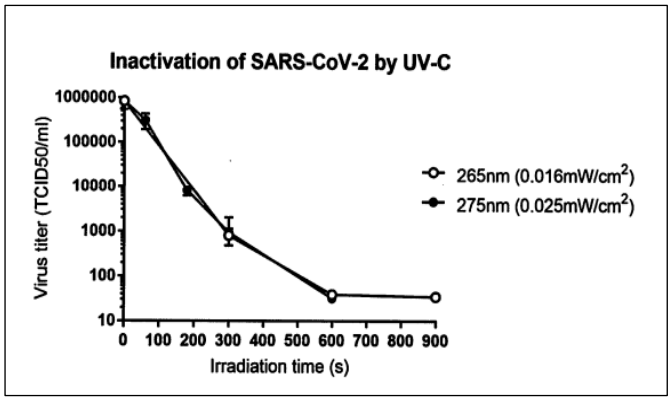


Fig.5 Test results for infection ratio of virus

	265nm	275nm
Inactivation of 99.99 %	600 esc.	600 sec.
Illuminance	0.016mW/cm^2	0.025mW/cm^2

Table 4. Illuminance required for inactivation by different wavelength

*Information provided on this news release was accurate at the time of announcement. Design of the product, date sale, specifications, etc. may change.

Contact Information:

North America ----------	Dave Lomas	+1-847-619-6700
Europe ----------	Andre Schmitz	+49-69-2992-4812
South China ----------	Martin Chen	+86-755-3293-0988
Hong Kong SAR----------	Clinton Lo	+852-2793-0613
East China ----------	Lian Chang Jun	+86-21-6295-5510
South East Asia / India ----------	Clinton Lo	+852-2793-0613
Other areas ----------	cej-UVC-info@citizen.co.jp	