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UV chip kills bacteria and preserves food

A collaboration between academia and industry has led to the development of a UV chip that eliminates microorganisms such as bacteria, fungi and viruses.



The EcoLoc device and lid fit onto the IKEA series of 365+ food storage containers -*PureFize Technologies*

The chip, developed by scientists from the LUMINOUS! Center of Excellence for Semiconductor Lighting and Displays at Nanyang Technological University, Singapore (NTU Singapore) and Sweden's PureFize Technologies, has been integrated into a commercially available product that preserves the freshness of food stored in containers.

"Our chip is a significant breakthrough in health and safety as it has the potential to eradicate harmful food spoilage microorganisms as well as reduce the spread of infectious diseases such as COVID-19," said senior research fellow Dr Vijay Kumar Sharma of NTU's School of Electronic and Electrical Engineering and LUMINOUS!

Unlike conventional UV lamps, the chip does not require mercury and is a few centimetres in size. The chip can also operate at full intensity in small, confined spaces without the need for cooling.

Environmentally friendly UVC alternative to mercury lamps

According to NTU Singapore, the most effective UV light for inactivating microorganisms is short wave UV (UVC), as it damages DNA and kills microorganisms.

Mercury lamps that emit UVC are commonly used to disinfect water and air. However, due to mercury's high toxicity, sustainability initiatives are phasing out mercury-based lamps and encouraging the development of more environmentally friendly disinfection technologies.

Instead of vaporising mercury to produce UV light, as in mercury lamps, the chip generates UVC through cathodoluminescence. The chip contains a cathode made of ZnO nanostructures and an anode coated with a material that emits mainly UVC when excited by electrons. When a voltage is applied, electrons are emitted from the cathode through field-emission, then accelerated in a vacuum by the electric field towards the anode, which emits UV light when hit by the electrons.

The chip emits UVC primarily around a wavelength of 265nm, along with a portion extending into the UVB (280 – 315nm) and UVA (315 – 400nm) regions. This combination leverages UVC to directly disrupt DNA while UVB and UVA penetrate and destroy difficult-to-eradicate communities of biofilms and cellular components such as proteins and lipids.

The chip operates at temperatures from -20 to 100 degrees Celsius and can be turned on and off instantly.

Proven effectiveness against bacteria and viruses

Laboratory tests showed that the UV chip effectively reduced pathogenic waterborne bacteria *Pseudomonas aeruginosa, Escherichia coli* and *Legionella pneumophila* after a few minutes of irradiation. The UV chip also eliminated SARS-CoV-2, the virus that causes COVID-19.

"The disinfection efficiency of our chip is on a par with conventional mercury lamps, and we are excited about the potential applications of the device in consumer products, including food containers, refrigerators, and medical technology applications," said Prof Hilmi Volkan Demir, director of LUMINOUS!

The chip has been incorporated into EcoLoc, a commercially available handheld device designed to be used with a specially developed food container lid – which fits the IKEA series of 365+ food storage containers - to help consumers keep food safe.

Using the chip, the shelf-life of various perishable foods, including bread, fruits, vegetables and meats, was extended to almost a week with minimal change in taste and odour.

Looking forward, the researchers aim to integrate the technology into other applications that prolong shelf-life and improve the safety and quality of foods.

The development is detailed in Advanced Optical Materials.

https://www.theengineer.co.uk/content/news/uv-chip-kills-bacteria-and-preservesfood/