

Beyond Sunlight: Smart LED Lighting

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Light Emitting Diodes (LEDs) are 20 times more efficient than incandescent bulbs and nearly 3 times more efficient than compact fluorescent lamps. It is even more important that LEDs can produce light optimized for specific needs and applications, such as light for treating seasonal affective disorder, growing plants, and preserving or even “restoring” paintings and objects of art. Many emerging applications are in medicine, lighting for seniors, merchandising, the automotive industry, photography, the film industry, and theatre lighting. We are truly in the middle of the smart lighting revolution. All these applications will benefit from new metrics of light quality - color rendition metrics demonstrated by a smart LED lamp - the “*color rendition engine*”.

But LEDs go beyond the visible range: they are capable of producing ultraviolet (UV) light. UV radiation finds numerous applications in water and air purification, sterilization, biological threat identification, medicine, biology, industrial processes, defense, and homeland security. Conventional ultraviolet mercury, xenon, and deuterium lamps are bulky, might contain mercury, produce ozone, require high voltages, slow to turn on and have a limited set of available wavelengths. UV LEDs are environmentally friendly and compact sources consuming low power and emitting at many wavelengths. Research is now underway to use these LEDs for increasing yield, improving quality, and extending the storage time of fruits and vegetables.¹ UV LEDs will help reduce waste, alleviate the problem of world hunger, purify water, kill bacteria and viruses, and solve the tremendous problem of Hospital Acquired Infections (leading to nearly 100,000 deaths annually in the United States alone).

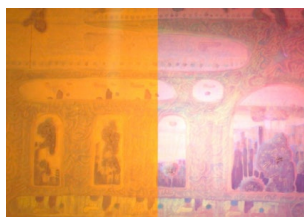


(a)



(b)

14 days of strawberries storage in the fridge at 6 °C: (a) and under exposure to 292 nm UV radiation (the power density of 50 mW/m²) (b)²



Fantasy. M. Čiurlionis Light from a halogen lamp (left); color rendition engine (right).³



Versatile solid-state lamp for treating the seasonal affective disorder⁴

¹ M. Shur and S. Britz, Fluorescent-based ultraviolet illumination, United States Patent Application Publication, US 2011/0147617, June 23 (2011), US patent 8,384,047, Feb. 26 (2013)

² M. Shur. Biomedical and Biotechnology Applications of Deep Ultraviolet Light Emitting Diodes, 2021 IEEE Research and Applications of Photonics In Defense Conference (RAPID), August 2-4 (2021), 978-1-6654-2223-9/21/\$31.00 ©2021 IEEE

³ A. Tuzikas, A. Liu, A. Žukauskas, R. Vaicekuskas, P. Vitta, A. Petrusis, M. Shur, Displaying Artwork with Tunable Colour Quality, ACS Colour 2013 Proceedings, Volume 1, pp. 43-46 (2013)

⁴ A. Žukauskas, M. S. Shur, and R. Gaska, Introduction to Solid State Lighting, John Wiley and Sons, 2002