Physiologically Friendly Healthy Light-at-Night: Solution-Process Feasible Blue-Hazard-Free Candlelight OLED

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Numerous medical studies highlighted that frequent exposure to improper light, such as intensive white light or light consisting of strong blue emission considerably suppresses the secretion of melatonin (MLT). When such lights are rapidly utilized at night, the lack of MLT secretion disturbs the human circadian rhythm including sleep-wake behavior, cell function and gene expression, jeopardizing human health. Moreover, circadian disruption by light-at-night markedly increases the risk of various types of cancers, including breast-, colorectal-, and prostate-cancers. The reason behind this may be a light source with high color-temperature or short wavelength light that has a remarkably high suppression effect on the secretion of the oncostatic hormone, MLT. Amongst all the lighting sources available in the market, candles and oil lamps are currently the friendliest lighting source to human eyes, physiology, ecosystems, artifacts, environment, and night skies due to their blue light-less emission. Unfortunately, these hydrocarbon-burning based lighting measures suffer from several disadvantages such as energy-inefficient, fire hazard, flickering nature, greenhouse gas releasing, and hard to tune or dim. Besides, they also release fine particles of PM2.5, which leads to the risk of lung cancer, the most common type of cancer occurred all over the world.

In response to the solution for the above-mentioned issues, here, we demonstrate the design and fabrication of electric driven low color temperature candlelight style solid state lighting source based on OLED technology, which is blue hazards free, besides being energy saving and physiologically friendly. The reason why OLED technology is preferred is because of its high degree of freedom in chromaticity design, besides showing plane-light, being soft, glare-free, thin, flexible, transparent, fully dimmable, and printable, etc. Furthermore, all the OLED devices were fabricated by cost-effective solution process and thermally activated delayed fluorescence the mechanism enabling exciplex forming co-host systems were used to precise confinement of charge carriers and excitons in the desired recombination zone, which are highly essential to improve device performance. The resulting 1,976 K candlelight OLED can reach a maximum brightness of 47,000 cd/m^2, equivalent to 51,900 candlelight in one square meter, and its efficacy is 180 times that of the candle (~0.27±0.03 lm/W) and 3.6 times that of an incandescent bulb (~15 lm/W). Additionally, the designed light source delivers a sensationally pleasant and warm environment.