Advantages and Weaknesses of LED Application

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Unlike conventional incandescent lamps which need to convert the electricity into thermal energy first and then to light, LED illumination is achieved when a semiconductor crystal is activated so that it directly produces visible light in a desired wavelength range. With the continuous development of lighting technologies, more possible future applications of LEDs will be seen. Advantages and disadvantages of using LEDs are to be discussed as follows.

Advantages of LEDs

1. Long Lifespan

The lifetime of conventional incandescent lamps is usually 3,000~4,000 hours. The ETTF (Estimated Time To Failure) of a LED is as long as 100,000 hours, which is much longer than that of incandescent lamps. Suppose we let a LED work four hours a day, we may have it work for us for more than 60 years.

2. Energy Saving and Low Cost

Generally speaking, LEDs are designed to operate with only 12~24V, and LEDs produce more light per watt than incandescent bulbs. High efficacy with low voltage makes it easy for LEDs to gain an edge up from conventional incandescent lamps, consuming 80% less electrical power. Although currently High-Brightness single-color LEDs are more expensive than conventional incandescent lamps, they save much more electrical power, which can offset the price gap. Suppose a LED requires 15W to reach a certain luminance, it would take up to 150W for a conventional incandescent lamp to reach the same level of luminance.

3. More Environmentally Friendly

Unlike incandescent bulbs and fluorescent lamps, LEDs emit light in a different way. LEDs do not rely on a filaments that will burn out, become heated, or disperse toxic gas. As a solid state component, LEDs are better able to withstand eternal shock. The illumination is generated solely by the movement of electrons in a semiconductor material, and its lifespan is similar to that of a standard transistor.

4. Environmental Adaptability

LEDs operate well in a wide range of temperatures, -40℃~+85℃, with the humidity below 65%. Therefore, LEDs can be used in a relatively harsh environment.

5. A Variety of Applications

LEDs have advanced from its use in numeric displays and indicator lights to a range of new and potential applications, including architectural lights, exit signs, accent lights, task lights, traffic lights, signage, cove lighting, wall sconces, outdoor lighting and down lighting, etc.

Weaknesses of LEDs

1. Bad Color Revivification

The general color rendering index of LEDs has been relatively low in the past, and the color reversion of LEDs is does not compare to that of incandescent bulbs. We all know that the lighting quality of incandescent lamps is excellent (CRI 100%) while white LEDs provide color rendering indices between 70% and 85%, better for daylight (6,000 K) than for warm white (2,900 K) LEDs. However, with the improvement

of phosphors and the technological upgrade of LED materials, some LEDs' CRI has been enhanced to 90%.

2. Single LED's Power is still Low

Due to the low power of a single LED, its luminance remains fairly low. Thus, more LEDs are required to be connected in parallel, such as in automobile backlights. More LEDs lead to higher cost, although the cost of a single LED is not high. At present, a single high-power LED is quite expensive yet its luminous intensity is just around 5,000 mcd.

3. Short Illumination Range

Although many methods have been developed to improve the brightness of the LED light source, it remains difficult to extend its illumination range. As LEDs emit scattered light, the illumination range is only tens of meters. Thus, LEDs are quite suitable for short-range lighting application. Nevertheless, with the development of new technology, LED's illumination range is expected to expand gradually.

4. "Yellow Ring" Phenomenon

Due to the immature process of white light LEDs and the error when configure the reflective cup and lens, "Yellow Rings" that frequently appear in white light LEDs are difficult to eliminate. In recent years, blended phosphor has been adopted to generate ideal white light with high CRI.

Take the blue light LED for example, it activates the mixture of YAG phosphor and green or red phosphor to generate white light. If the blue light LED, after activating YAG phosphor, emits white light with a "yellow ring", green light (wavelength 500nm～530nm) phosphor may be added to counteract the unwanted yellow light. Similarly, if the blue light LED, after activating YAG phosphor, emits white light with a "blue ring", red light phosphor without sulfide may be added to counteract the unwanted blue light. These methods can regulate not only the color coordinates but also the color temperature of LEDs, without affecting the lifespan of the LEDs.

5. Heat Dissipation

Heat generated by the acting light emitting chip for the LED must be absorbed to maintain normal working temperature to prevent over-heating or damaging the chip. Industry players strive to develop more efficient heat-dissipating materials.

Although LEDs bear several imperfections which need to be improved in the future, they possess many advantages over conventional incandescent lamps. As a next-generation light source, offering benefits such as its compact size, long lifespan, energy-efficiency, and durability, LEDs have aroused tremendous interest among different countries and regions. With the rapid advancement of LED industry all over the world, we believe that these imperfections of LEDs will be corrected in the foreseeable future.

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