

The LED Revolution By Travis Craig

Lighting as we know it is changing. In response to increasing energy standards and consumer's needs for greener and safer technology, the old ways of lighting are quickly disappearing. Incandescent bulbs are not holding their weight, converting too much energy into heat and lasting a relatively short amount of time. Fluorescent lights, a little more efficient than incandescent bulbs, are still filled with harmful elements and lack the color warmth that incandescent lights provide. However, LEDs (light emitting diodes) are quickly filling in the gaps that the conventional lighting methods leave wanting. With increasing brightness and a full range of colors, the LED is coming to replace traditional lighting.

The reason for this is due to the difference in technology between LED lights and the others. LED lights differ from the other two mostly in terms of what it is that produces the light being emitted. Incandescent lights heat up a tungsten filament until it glows. For as long as it can, inert gas keeps the tungsten from evaporating and deteriorating due to the intense heat created by the current sent through it. When the tungsten has eventually depleted itself, the bulb goes out. Fluorescent lights, on the other hand, send an electrical current through gaseous elements to cause those elements to glow. UV light created from the glowing gas is sent to the outer edges of the bulb where it interacts with a phosphor coating. This coating turns the UV light into the trademark blue-pale visible light that most fluorescent bulbs are known for.

LEDs, differing from the other two, produce light from a chip, also called a die. The chip is composed of semiconductor material, meaning that it partially conducts electricity, and is comprised of a positively charged half and a negatively charged half. When an electrical current is sent through the chip, electrons from the negatively charged layer of the semiconductor fill in positive "holes" in the positively charged layer. In order for an electron to drop into a positive hole, that electron must lose energy. This energy is expelled from the electron in the form of photons. These photons are the light that comes from an LED. The extremity of the drop of an electron determines the frequency of the photons that are being emitted, and the frequency of the photons determines the color to be seen. A greater energy drop will result in higher frequencies which produce bluer shades of color, and a lesser energy drop will produce lower frequencies which produce redder shades of color. The material used to create the positive and negative layers of the LED chip and the voltage of the current running through those layers determine the sort of energy drop produced, so a wide range of color creation is possible. White color can even be created, using one of a few methods. One way to create white LED light is to use fluorescent coating on the casing of an LED to alter the light produced by certain LED chip materials. Materials that create a near-UV light use blue, green, and red fluorescence as coating to produce a white color. The fluorescence, when interacting with the original light, produces its own light that is within the visible spectrum and appears white. Similarly, blue light created by a current sent through a chip is combined with yellow fluorescent coating to produce a white light. Alternatively, red, green, and blue LEDs are combined to produce a white light. These and other methods of color control are used to create a range of colors that may apply themselves to all sorts of everyday applications.

This color control and the design of LEDs in general make LEDs unique from other lights.

Therefore, due to the design differences between incandescent and fluorescent lights and LED lights, several advantages in LEDs make themselves apparent over the older designs. The greatest advantage that LEDs have over older alternatives is that they last thousands of hours longer. Because LEDs do not burn a filament, there is no need to worry about exhausting the main ingredient of the design. Instead, LEDs use electroluminescence to send off light, a process that leaves the material used relatively undiminished. And this difference means that LEDs are capable of life spans of about 50,000 hours. Some even claim that LEDs can last 70,000 hours. That's equivalent to about eight years if the light is left on indefinitely. Even fluorescent light bulbs do not reach that sort of life span. In addition to longevity, LEDs produce a fraction of the heat that incandescent and fluorescent lights do. And this translates into greater energy efficiency. To achieve the same sort of light that an LED would offer over the whole of its lifetime, other sources would require more wattage and would need to be replaced relatively frequently, using up money that could otherwise be spent more efficiently towards other expenses.

As for the angle of illumination, LEDs are excellent at spot lighting, which is lighting a certain, focused area, a "spot," as opposed to lighting everything around. The reason LEDs are good at this is that the chip in an LED is positioned to give off light in a 120° angle, a result of the LEDs design. This angle can be adjusted by a lens to emit light in even more focused beams, allowing for great luminescence where you want it and no luminescence where you don't. Further light control is offered by LEDs through their acclimation with dimmer systems. When being dimmed, LED lights do not experience the flicker effect that fluorescent lights often do. They turn on instantly and can be dimmed to a variety of levels. Another advantage, as stated previously, is the range of colors that LEDs may come in. From traffic lights to Christmas decorations, LEDs offer colors that are sharp and clear. Thus, the paleness of typical fluorescent light bulbs can be avoided, and the yellowish tint of many incandescent light bulbs need not be tolerated either. True white light and other colors can be achieved by LEDs.

But more than that, UV light and infrared light are also controllable through LEDs. Because the color of an LED is largely dependent upon the material used to create the light, choosing a material that produces UV or infrared light is very easy. Inversely, avoiding those ranges of light is just as easy. Even within the frequencies that produce UV light, control is possible. LED light can be made to achieve UV-A, -B, and -C light. And these varying levels of UV light can be used in different ways. Eliminating such light is, of course, also very applicable.

In addition to featuring better life spans, heat outputs, and color options, LEDs are much more eco-friendly and durable than other lights. Because of the design, LEDs are not prone to shattering like fluorescent and incandescent lights are. Many LEDs use materials that are simply more durable than those employed by incandescent and fluorescent lights. Thus, the rough usage that might destroy an incandescent or fluorescent bulb may not destroy the LED at all. Moreover, LEDs have recyclable components. In fact, some retailers claim that their LED lights are entirely recyclable. While not all recycling centers have programs that include LED lights, effort is nonetheless being made to acclimate LED designs to such programs. Another eco-

friendly feature of LEDs is that they do not contain mercury. Fluorescent light bulbs do. Mercury is one of the gases that current is passed through to create a glow in fluorescent lights. However, regarding lead content, some reports claim that LEDs do contain a noticeable amount. But some companies claim that their LEDs do not contain lead, so the current status of the lead content of LED lights is unclear. This and other concerns can be addressed and resolved as the ever-growing future of LEDs comes into the present.

What is hard to tell at this point is the extent to which LED lighting will come to replace conventional lighting methods. Right now, **residential lighting** seems like more of a goal than a reality, but the progress made with LEDs in the residential area thus far shows promise. And overall, LEDs may come to represent the bulk of the lighting applications industry in the not-too-distant future. As it is now, LEDs have broken ground in the commercial and industrial lighting arenas. And the uses for LEDs there are numerous. **Commercial** venues already find LEDs very capable of general area lighting. Entire rooms—elevator banks, waiting rooms, hallways, stairways, conference rooms, or others—can be illuminated by LEDs. Their downward-focused lighting ability lets them illuminate whatever area might be below them.

Furthermore, indoor and outdoor spotlighting needs alike can benefit from LED precision. The efficiency of a focused light angle mixed with a compelling color rating index easily accomplishes such tasks. As such, LEDs are great at pointing out the artful angles of a building's architecture, highlighting paintings and sculptures (the absence of UV light is especially beneficial in such uses), illuminating storefront signs, and showcasing products on display. Aesthetically speaking, LEDs are perfect for these jobs.

And besides illuminating buildings and artwork, LED lights may be used for other, more practical outdoor lighting tasks. For example, LEDs can now be found in parking lot lamps. They can be used in motion sensor lighting systems and in walkway lamps as well, not to mention as street lamp lights. LEDs can even be used in traffic signals. Also, LEDs can benefit the **industrial** lighting scene. Besides general area lighting, LEDs can be used within heavy duty settings such as in mines, mine tunnels, and cold storage units. This is because LED durability lends itself well to illuminating industrial sites and locations which involve great amounts of turbulence and extreme conditions.

To meet the lighting demands these venues make, some retailers and electric supply companies sell and recommend LED lights for various commercial and industrial projects. The Furbay Electric Supply Company, for example, offers recessed lamps at various color temperatures which may be used in a variety of commercial lighting applications. Furbay also features lights that may be used in residential applications, offering under-cabinet bulbs and candle-shaped bulbs. These bulbs, because they are LEDs, run at very low wattages, consuming as little as a watt and a half of power. Furthermore, Furbay carries outdoor LED lights, such as those used in parking lots. And those lights, which normally consume seventy to one-hundred watts, only require ten to twenty watts because of LED innovation.

As lighting technology continues into the future, LEDs will likely find themselves in an ever increasing number of applications. Even now, LEDs are making their way further into the residential lighting scene, looking to replace the conventional incandescent light bulbs. Incandescent lights, along with fluorescent lights, are slowly being discovered as secondary in efficiency to the LED. And while LEDs are not yet

through the process of emerging, dealing with such issues as heat output and omnidirectional illumination, people are making them better and cheaper. In fact, Haitz's law, a formula created to predict the cost of LEDs over time, indicates that the price of LEDs will decrease by half every decade. In very little time, then, LEDs could become the cheapest lighting option on the planet.

At present, various countries, including the U.S., are seeing an increase in the LED market, which corresponds to the falling usage of incandescent light bulbs. Many countries are beginning to oust incandescent bulbs altogether, leaving LEDs to fill some of the initial gap created. After the downfall of the incandescent light bulb, the efficiency of LED lights will likely carry the technology on to become the dominant form of lighting, surpassing even fluorescent bulbs. This change—the next lighting revolution—is already in motion, and today's younger generations will see within their lifetimes whether or not that revolution is a success.