

White LEDs are Blue LEDs!

By Barb Hamilton

No one in the lighting industry is debating that LEDs as a light source are unique, exciting, and here to stay. For the first time in decades we need a new vocabulary and knowledge base to properly apply this source in our work and for the benefit of customers. This is the first in a series of overviews meant to build an understanding of LED technology and what the lighting design community needs to know to confidently discuss and successfully apply this electrifying technology. This discussion centers on how LEDs have become a viable general lightsource in recent years.

Light Emitting Diodes (LEDs) were originally developed in the 1960s. As the name implies, an LED is a semiconductor diode that is configured to emit light when an electric current passes through the LED chip inside the "package". As seen in Figure 1, a complete LED package contains all the parts required to produce and direct the light and dissipate the heat produced in the process.

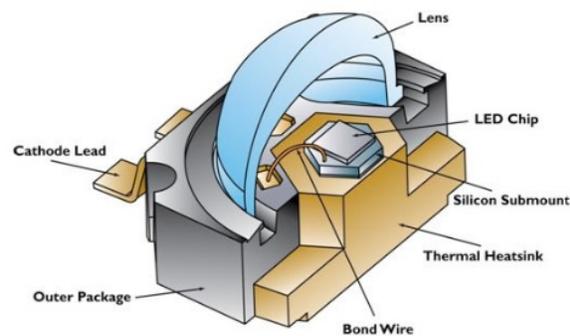


Figure 1: A cross-section of a Philips Lumileds LED package. Courtesy of ALG Online.

The first LEDs were single-color red, yellow and green devices and were built as leaded packages. These saw widespread use in consumer electronics as indicator lights and display segments. Though LEDs could be bright sources of colored light, total lumen outputs for single packages remained low. In the mid-1990s, advances in materials technologies enabled the development of higher-output chips. Of particular note was the creation of a high-output blue LED technology, which then precipitated the creation of the first practical white LED systems.

The white LED approach uses a phosphor coating on a blue (possibly UV) LED chip. The resulting spectral light output shows a sharp blue spike (from the blue chip) and a wider distribution covering the green, yellow and red portions of the spectrum, provided by the phosphor coatings. Figure 2 (next page) shows the spectral distribution of three different white LEDs, identified in the key by their color temperature ranges (CCT). The LED spectral distribution is unlike our incumbent light sources and is often discussed by researchers for its potential to affect humans, in both positive and negative ways.

We are all aware of the early attempts with this method – bluish-white light, with a very high color temperature, poor color rendering and uneven color in the light beam. Significant advances in phosphor technologies, in particular the addition of red enhanced phosphors, have enabled the development of warm white LEDs.

ABOUT ALG Connections

Through a series of abstracts and synopses, ALG Connections informs readers on timely topics such as research, conference reviews, industry trends and technology updates.

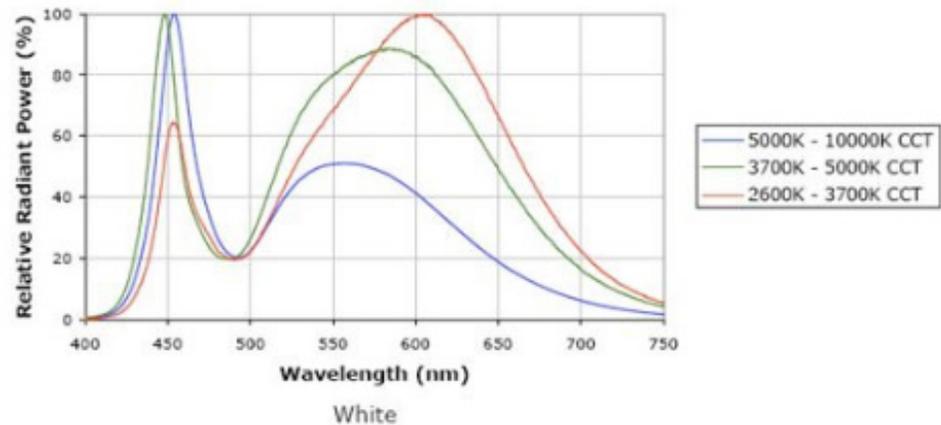
ALG Online is one of the design guides offered by New Buildings Institute (NBI) through its Advanced Buildings® suite of tools and resources.

Visit us for more information about New Buildings Institute at newbuildings.org, ALG Online at algonline.org and Advanced Buildings at advancedbuildings.net.

Significant advances in phosphor technologies, in particular the addition of red enhanced phosphors, have enabled the development of warm white LEDs.

Figure 2: White LED relative radiant power by wavelength, showing the blue spike around 450nm and the other colors of the spectrum as produced by phosphor coatings.

Graphic courtesy of Cree, Inc. as taken from ALG Online.



Some manufacturers have perfected their own 'mix' in their LED modules, sometimes adding amber or red diodes to improve color. Currently, we have good performing options available, including those that provide the familiar warmth of our traditional incandescent sources (2700K).

We more often see white LEDs used in general illumination because of lower costs and simpler design advantages over RGB (Red-Green-Blue color mixing) systems. A white LED is much closer to a traditional light source and is therefore better accepted by users. This provides a reasonable evolution for general illumination, and in recent years the use of white light LED lighting systems has skyrocketed, resulting in explosive technology growth and development.

For more information on LEDs and other lighting technologies and information, visit: [Advanced Lighting Guidelines \(ALGOnline.org\)](http://AdvancedLightingGuidelines(ALGOnline.org)).

Barb Hamilton is the Senior Lighting Manager at New Buildings Institute. Her experience includes lighting design, product sales and marketing and several educational functions. Barb leads NBI's involvement in commercial lighting by managing the Advanced Lighting Guidelines online resource (known as ALG Online) and working collaboratively with sponsors to move advanced lighting practices and products into the market.

Special thanks to Northwest Energy Efficiency Alliance for their support in developing these ALG Connections pieces on LED technology.