

Newest Kid on the Block: LEDs and OLEDs!

Source: Wikipedia.org

Edited by William Lee Joel, II, Senior Lighting Specialist, Richmond Art Company



A [light-emitting diode](#) is a semiconductor device that emits narrow-spectrum [light](#) when electrically [charged](#) in the forward direction. This effect is a form of [electroluminescence](#). The [color](#) of

the emitted light depends on the chemical composition of the semiconducting material used, and can be near-[ultraviolet](#), [visible](#) or [infrared](#). [1]

A diode is defined as an electronic device that restricts current flow to one direction. It is an electron tube having a cathode and an anode.

Rubin Braunstein (born 1922) of the [Radio Corporation of America](#) first reported on infrared emission from GaAs and other semiconductor alloys in 1955. [Nick Holonyak, Jr.](#) (born 1928) [2, 3] of the [General Electric Company](#) developed the first practical visible-spectrum LED in 1962.

An LED is a special type of [semiconductor diode](#). Like a normal diode, it consists of a chip of semiconducting material impregnated, or doped, with impurities to create a If the emissive layer material of an LED is an [organic compound](#), it is known as an [Organic Light Emitting Diode \(OLED\)](#).

Today, OLEDs operate at structure called a [p-n junction](#). As in other diodes, current flows easily from the p-side, or [anode](#), to the n-side, or [cathode](#), but not in the reverse direction.

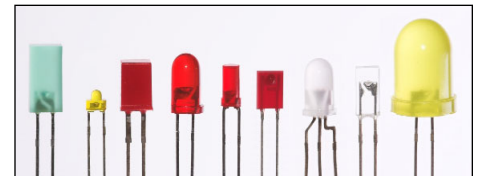
Today, OLEDs operate at a substantially lower efficiency than inorganic (crystalline) LEDs. The best efficiency of an

OLED so far is about 10%. These promise to be much cheaper to fabricate than inorganic LEDs, and large arrays of them can be deposited on a screen using simple printing methods to create a color graphic display.

Advantages of Using LEDs

- LEDs are capable of emitting light of an intended color without the use of color filters that traditional lighting methods require.
- The shape of the LED package allows light to be focused. Incandescent and fluorescent sources often require an external reflector to collect light and direct it in a useable manner.
- LEDs are insensitive to vibration and shocks, unlike incandescent and discharge sources.
- LEDs are built inside solid cases that protect them, making them hard to break and extremely durable.
- LEDs have an extremely long life span: typically ten years, twice as long as the best fluorescent bulbs and twenty times longer than the best incandescent bulbs.
- Further, LEDs fail by dimming over time, rather than the abrupt burn-out of incandescent bulbs.
- LEDs give off less heat than incandescent [light bulbs](#) with similar light output.
- LEDs light up very quickly. An illumination LED will achieve full brightness in approximately 0.01 seconds, 10 times faster than an [incandescent light bulb](#) (0.1 second), and many times faster than a [compact fluorescent lamp](#), which starts to come on after 0.5 seconds or 1 second, but does not achieve full brightness for 30 seconds or more. A typical

red indicator LED will achieve full brightness in microseconds, or possibly less if it's used for communication devices.



LEDs are produced in a staggering array of shapes and sizes. Though the color of the plastic lens cannot be guaranteed to correlate with the actual color of light emitted by the LED (for instance, purple plastic is often used for [infrared](#) LEDs), when not completely clear, it is often a good indicator.

Disadvantages of Using LEDs

- LEDs are currently more expensive than more conventional lighting technologies. The additional expense partially stems from the relatively low lumen output (requiring more light sources) and drive circuitry/power supplies needed. A good measure to compare lighting technologies is lumen/dollar.
- LED performance largely depends on the ambient temperature of the operating environment. "Driving" an LED 'hard' in high ambient temperatures may result in overheating of the LED package, eventually to device failure. Adequate heat-sinking is required to maintain long life. This is especially important when considering automotive/military applications where the device must operate over a large range of temperatures, with government-regulated output.

Illumination Applications

LEDs used as a replacement for [incandescent bulbs](#) and [fluorescent lamps](#) are known as [Solid State Lighting \(SSL\)](#) LEDs. SSL LEDs are packaged as a cluster of white LEDs grouped together to form a light source. LEDs are moderately efficient: the average commercial LED currently outputs 32 [lumens](#) per [watt](#) (lm/W), and new technologies promise to deliver up to 80 lm/W. They are also more mechanically robust than incandescent light bulbs and fluorescent tubes. LEDs today are not sold in many places, require power source conversion in household applications, and are relatively expensive, although their costs are decreasing.

Incandescent bulbs are much less expensive but also less efficient, generating from about 16 lm/W for a domestic [tungsten](#) bulb to 22 lm/W for a halogen bulb. [Fluorescent tubes](#) are more efficient, providing 50 to 100 lm/W for domestic tubes (average 60 lm/W), but are bulky and fragile and require starter or ballast circuits that sometimes buzz audibly. [Compact fluorescent light bulbs](#), which include a quiet integrated ballast, are relatively robust and efficient, fit in standard light bulb sockets, and are **currently the best choice for efficient household lighting**.

Proponents of LEDs expect that technological advances will reduce costs such that SSL can be introduced into most homes by 2020. However, they are still not commercially viable for general lighting applications, and so LEDs are found today in illumination applications where their special characteristics provide a distinct advantage.

Due to their monochromatic nature, LED lights have great power advantages over white lights when a specific color is required. Unlike traditional white lights, the LED does not need a coating or diffuser that can absorb much of the emitted light. LED lights are inherently colored, and are available in a wide range of colors. One of the most recently introduced colors is the emerald green (bluish green, about 500 nm) that meets the legal requirements for traffic signals and navigation lights. ■



Small spotlights made of many individual LEDs

Acknowledgement

Richmond Art Company acknowledges and credits the main source of this article to Wikipedia.org. The original paper may be viewed from <http://en.wikipedia.org/wiki/Led>. We thank all Wikipedia contributors who expand our knowledge of lighting.

About the Author

Bill Joel received his B.A. from Brown University with creative design courses at the Rhode Island School of Design. He did further studies in interior and lighting design at the New York School of Design and Pratt Institute.

A professional member of AID-ASID from 1963 to 1993, Bill received a Fellowship from ASID in 1978. In 1992, he became one of the first Certified Interior Designers of the Commonwealth of Virginia. His work experience includes residential, commercial and institutional remodeling and new structures, as well as a number of feasibility studies, all with an emphasis on effective, energy-conscious,

quality-lit environments. For more details, consult *Marquis Who's Who in America*. Bill has also served as a member of the FIDER Board of Visitors and Accreditation Committee, Foundation for Interior Design Education and Research; set and lighting designer for the Richmond Forum and Barksdale Theatre; and guest speaker on various radio and TV spots. Bill may be reached at Rich@RichArtCo.com.

Notes