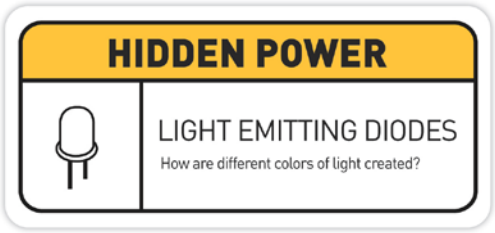

Question & Answer Fact Sheet

What are LEDs and how are they used?

Diodes are common circuit elements that are used to control the flow of electrical current. Current will flow in one direction through a diode but will not flow in the opposite direction. A light emitting diode is a special type of diode that emits light when current flows through it. The color of the light emitted is determined by the composition of the material used to fabricate the diode. For example, an LED that is comprised of indium gallium nitride (InGaN) emits blue light. If the nitrogen atoms (N) are replaced with phosphorus (P), and aluminum (Al) is added to form aluminum indium gallium phosphide (AlInGaP), then the LED will emit red light instead. The change in composition alters the energy transitions in the material that are responsible for producing light. The energy transition that occurs in InGaN is larger than that which occurs in AlInGaP; consequently, the light that is emitted from InGaN is higher energy (blue) than that emitted from AlInGaP (red). Therefore, by varying the composition of diode materials, it is possible to produce LEDs that emit light all the way from the ultraviolet/violet range through the entire visible spectrum and into the red/infrared range.

Creating “white” light from LED’s is a challenge, however, because natural “white” light contains all wavelengths (i.e. all colors) of light. LEDs are currently used to produce white light in two different ways. First, white light can be created by color mixing red, green, and blue light from individual red, green, and blue LEDs. Second, the light from a high energy blue LED can be used upon a phosphor, which absorbs it and then emits white light. The phosphor–based white LED works similar to a fluorescent light bulb and is currently the most popular method for making white LEDs because it is simpler and cheaper than using many multi-colored LEDs.

What kinds of devices or applications utilize LED technology?

- Ultraviolet light can be used to kill bacteria and other microorganisms; consequently, UV LEDs are of interest for medical applications and water purification.

- There is significant interest in the use of LEDs for lighting applications since they have longer lifetimes than incandescent bulbs and consume less energy. Green, red, and amber LEDs are used in traffic signals; red LEDs are used for brake lighting in automobiles. White and multi-colored LEDs are also used as backlighting for LCD televisions to reduce energy consumption and improve contrast. Interestingly, one downside to having LED traffic lights is that, in a snowstorm, snow can accumulate and hide these lights from motorists because not enough heat is generated to melt it away. For the same reason, however, LED Christmas lights are beneficial because they are much less likely to cause a dry tree to catch fire.

- Infrared LEDs are used in remote control devices to enable communication between the handheld remote and the television (or other consumer electronic device).

What is the primary advantage and disadvantage of LED technology?

LEDs are already revolutionizing the lighting industry by enabling a dramatic reduction in energy consumption while also providing new directions for lighting design in buildings and homes. The main disadvantage of current LED-based lighting is the higher initial cost of the bulb compared to incandescent or fluorescent lights. Another disadvantage, according to consumers, is their lack of brightness and aesthetic appeal (white lights have no warm glow). LED's also are one-directional by nature, and therefore require additional bulb design features in order to create ambient light.

What's happening on the cutting edge of research in this area right now?

White LEDs that are created by color mixing red, green, and blue LEDs offer the pathway to highest energy efficiency. They also provide unique opportunities in lighting design by enabling users to vary the hue of the LED to generate "cool" white or "warm" white by adjusting the intensities of the individual red, green, and blue LEDs. High efficiency red and blue LEDs are available but the efficiency of green LEDs is not yet high enough to make this a cost effective approach. Current research in this area is focused on improving the efficiency of green LEDs.

The development of organic LEDs is another active area of research. In this case, organic compounds similar to plastic are used as the light emitting material. Organic LEDs are lightweight and are less expensive to manufacture compared to traditional LEDs. In addition, they can be fabricated on flexible plastic substrates to make roll-up color displays.

Image source: http://www.compudio.ca/2009/01/top-10-gadgets-from-ces-2009.html

Companies that manufacture LEDs:

Cree http://www.cree.com/

Phillips Lumileds http://www.philipslumileds.com/