# HOW LED WORKS ?

An LED or “Light Emitting Diode” is a special type of diode that is specifically optimized to give off light, usually in the visual or infrared spectrum, as electricity is passed through it and contribute to reduction in carbon dioxide emissions.

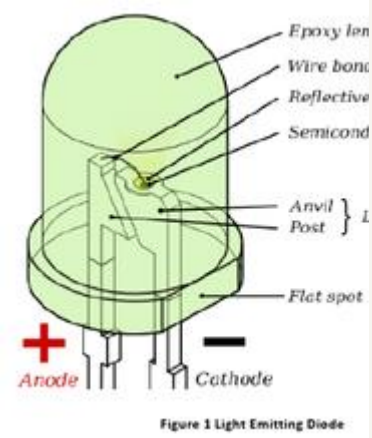


Figure 1 Light Emitting Diode

Basically, LEDs are just tiny light bulbs that fit easily into an electrical circuit. But unlike ordinary incandescent bulbs, they don't have a filament that will burn out, and they don't get especially hot.

The LED has following basic parts :

Connecting Leads

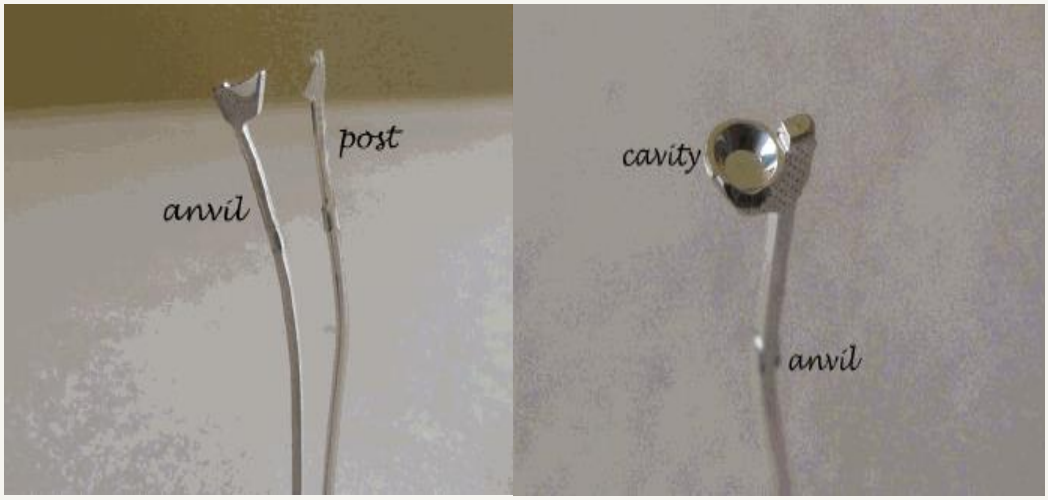
Diode

Transparent Plastic Case

Emitted Light Beams

1. Connecting Leads

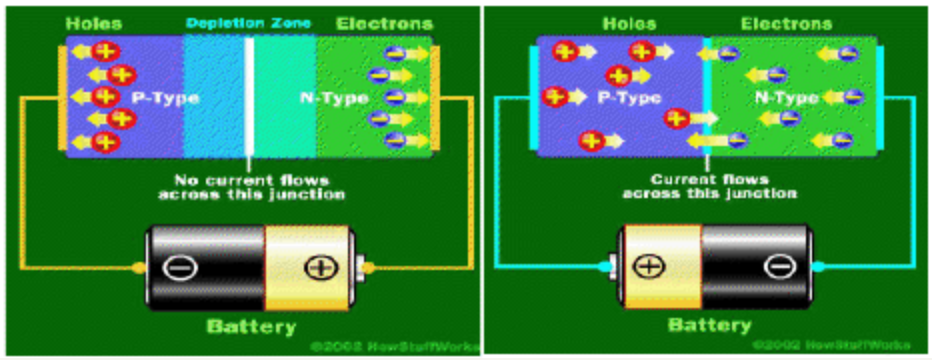
There are two leads of an LED that are used to supply input voltage. The longer lead is positive and known as ‘Post’, and the smaller is negative known as ‘Anvil’ as shown in the image below. A metal cup is placed on the negative lead (Anvil) which holds a semiconductor die. The semiconductor die is a combination of two semiconductor materials – N type and P type and an active region (known as P-N junction) between them.



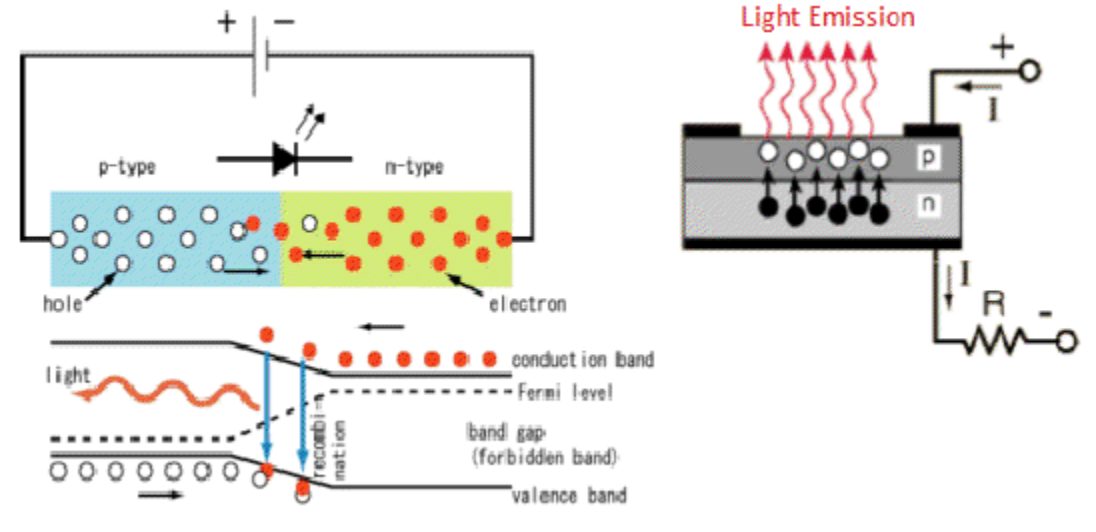

2. Diode

A DIODE is a special type of semiconductor that has many uses. One of the principle uses though is to control the direction of the flow of electricity. The most common type of diode does this by using something called “p-n junctions”. This is just a fancy way of saying “magic”.

As the electricity jumps across the p-n junction, the electrons from the “n-type” side “fill holes” in the “p-type” side. During this process, the electrons end up changing their state. During this state change, a photon is emitted. More specifically what is going on is, as electrons move around orbiting a nucleus of an atom, electrons with different orbits have different amounts of energy. Electrons with orbits farther away from the nucleus have greater energy and ones closer have less energy.



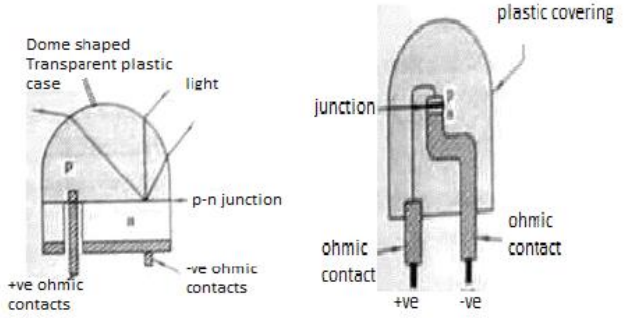

So in order for an electron to change its orbit, it needs to either lose energy or gain energy. What we are interested in with LEDs are the electrons going from a higher orbit to a lower orbit, thus losing energy in the form of a photon of light. When the electrons from the n-type side “fill the holes” in the p-type side, they then lose energy in the form of these light photons. The greater the energy release, the higher the frequency the light photon given off, thus changing the colour.




The size of the gap determines the frequency of the photon -- in other words, it determines the color of the light. If the frequency ends up being in the human visible spectrum (the range our eyes can see), then we’ll see the light being given off by the LED.

3. Transparent plastic case


**Figure 4 Close view of metal case holding semiconductor die**




The entire assembly is encapsulated in an epoxy glass case. The shape of the glass gives directionality to the light emitted from semiconductor die. The LED is available in many shapes, basically dome, rectangular, indicator and cylindrical.

4. Emitting Light Beams

Light Emitting Diodes are made from exotic semiconductor compounds such as Gallium Arsenide (GaAs), Gallium Phosphide (GaP), Gallium Arsenide Phosphide (GaAsP), Silicon Carbide (SiC) or Gallium Indium Nitride (GaInN) all mixed together at different ratios to produce a distinct wavelength of colour. Different LED compounds emit light in specific regions of the visible light spectrum and therefore produce different intensity levels. The exact choice of the semiconductor material used will determine the overall wavelength of the photon light emissions and therefore the resulting colour of the light emitted.

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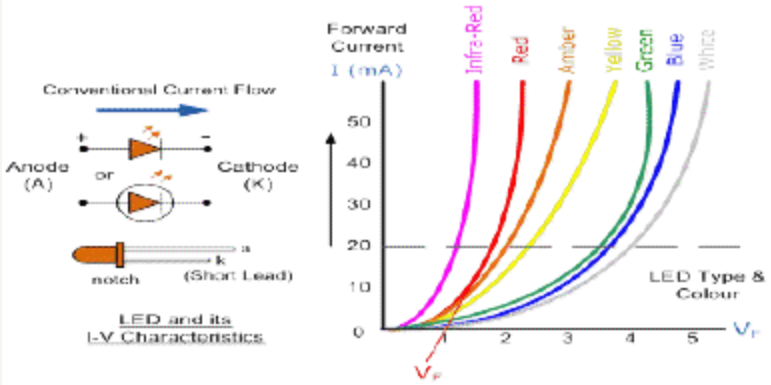
| Typical LED Characteristics | | | |
|---|---|---|---|
| Semiconductor Material | Wavelength | Colour | $V_F$ @ 20mA |
| GaAs | 850-940nm | Infra-Red | 1.2v |
| GaAsP | 630-660nm | Red | 1.8v |
| GaAsP | 605-620nm | Amber | 2.0v |
| GaAsP:N | 585-595nm | Yellow | 2.2v |
| AlGaP | 550-570nm | Green | 3.5v |
| SiC | 430-505nm | Blue | 3.6v |
| GaInN | 450nm | White | 4.0v |

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