

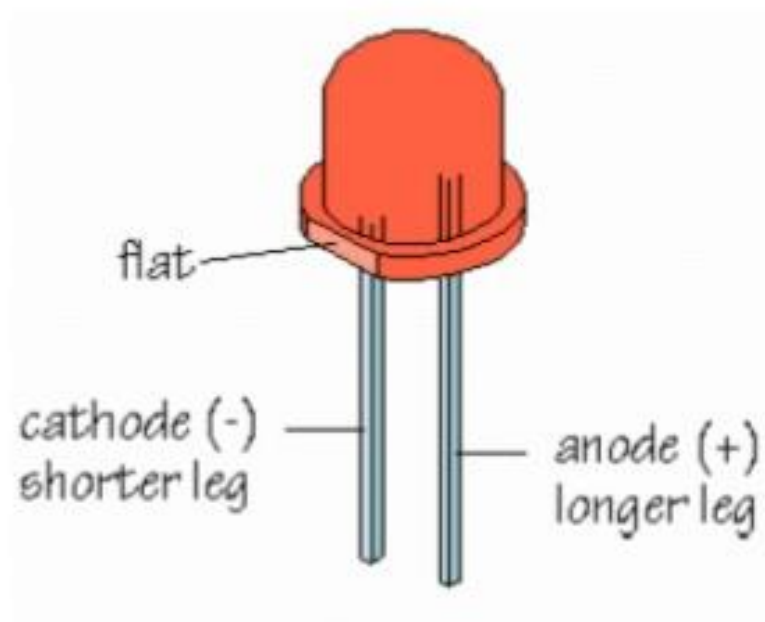


L.E.D. Light Emitting Diode

JAMAL BASHA K.A.
Lecturer In Physics
Govt.Degree College,
Porumamilla,kadapa

What is an LED?

- Light-emitting diode
- Semiconductor
- Has polarity

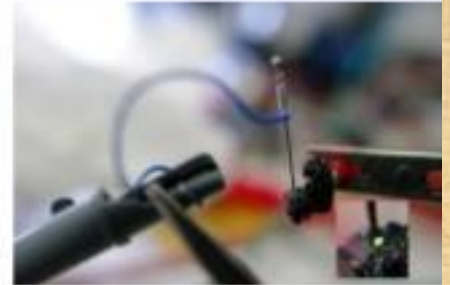


History



Captain Henry Joseph Round, *England*

- ✦ First observation of *Electroluminescence* from SiC crystals in the year 1907



Oleg Vladimirovich Losev, *Imperial Russia*

- ✦ Reported light emission from rectifier diode in 1927
- ✦ A talented scientist who spent his life working as technician
- ✦ Published 43 articles in top Russian, British and German journals as a *sole author* and was granted 16 patents *without getting any formal education*
- ✦ Died in 1942 at the age of 39 during the blockade of Leningrad



Nick Holonyak, *GE New York, USA*

- ✦ *The father of the light-emitting diode: invented the first practically useful visible LED in 1962.*
- ✦ His father worked in a coal-mine & he was the first member of his family to receive any formal schooling.
- ✦ First PhD student of *John Bardeen*

History



Shuji Nakamura, *Nichia Corp., Japan*

✦ *Inventor of high-brightness GaN based LEDs*

✦ *P-type doping of GaN, high quality InGaN thin films, blue green, white LEDs and blue laser diodes*

✦ *The general conclusion among scientists at this time is that Dr. Nakamura's inventions are so reliable and energy efficient that they are destined to replace Thomas Edison's light bulb and save the world billions of dollars in energy costs.*

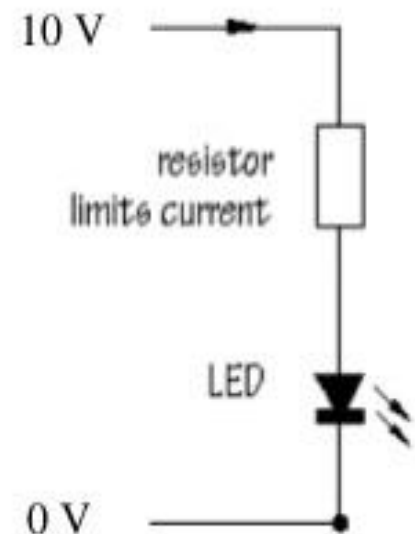
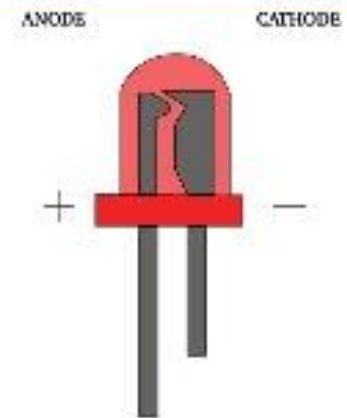
What is a Light-Emitting Diode (LED)?

- A device that converts *electrical energy into Light*
- A p-n junction diode that *emits monochromatic light when forward biased.*



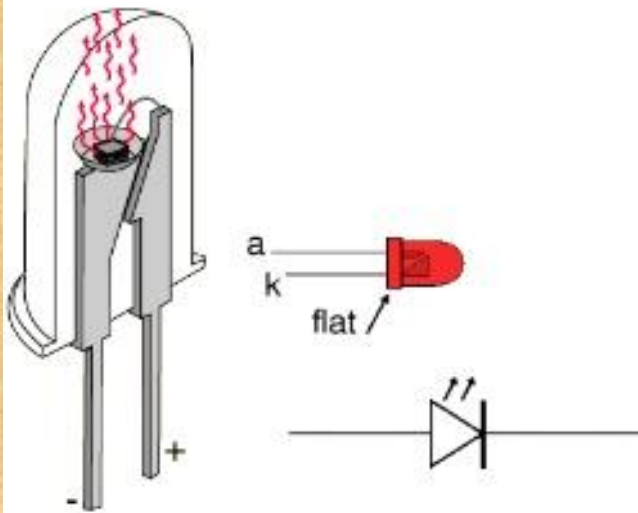
Symbol

- Requires 1.5 ~ 4 V and 10 mA to turn **ON**
- One needs to use a resistor to prevent overloading



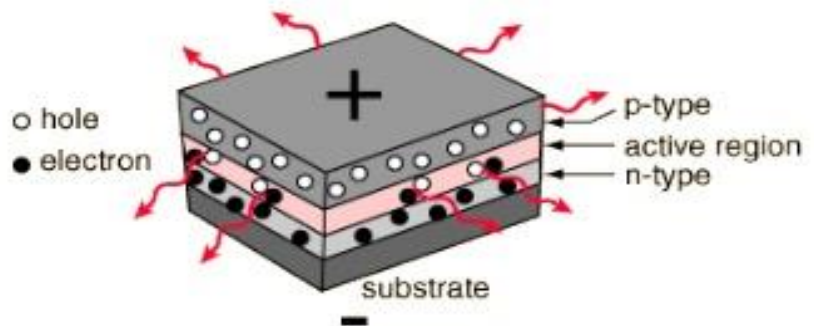
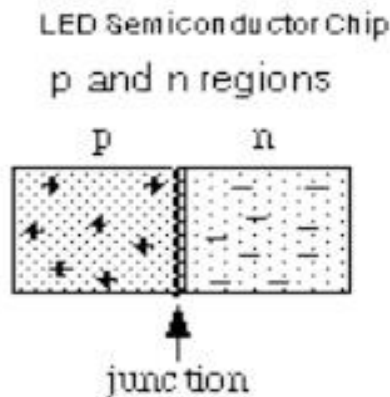
About LEDs (1/2)

- A light emitting diode (LED) is essentially a PN junction opto-semiconductor that emits a monochromatic (single color) light when operated in a forward biased direction.
- LEDs convert electrical energy into light energy.

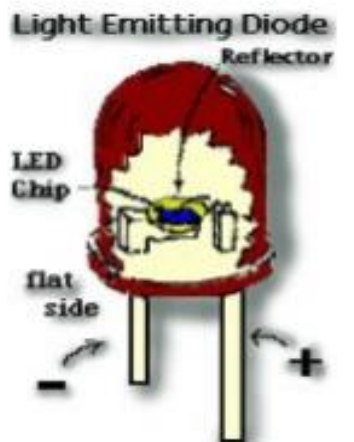


ABOUT LEDS (2/2)

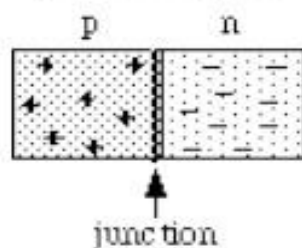
- The most important part of a *light emitting diode (LED)* is the semi-conductor chip located in the center of the bulb as shown at the right.
- The chip has two regions separated by a *junction*.
- The *junction* acts as a barrier to the flow of electrons between the *p* and the *n* regions.



HOW DOES A LED WORK? (1/2)

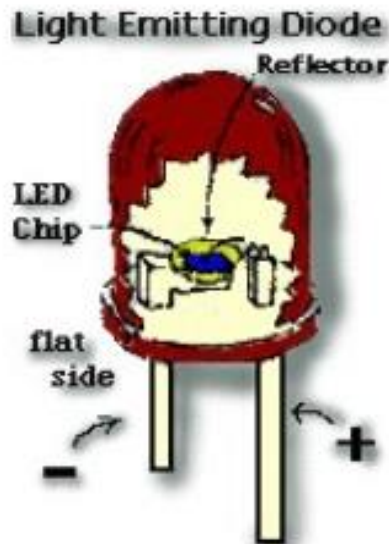


LED Semiconductor Chip
p and n regions



- When sufficient voltage is applied to the chip across the leads of the LED, electrons can move easily in only one direction across the junction between the *p* and *n* regions.
- When a voltage is applied and the current starts to flow, electrons in the *n* region have sufficient energy to move across the junction into the *p* region.

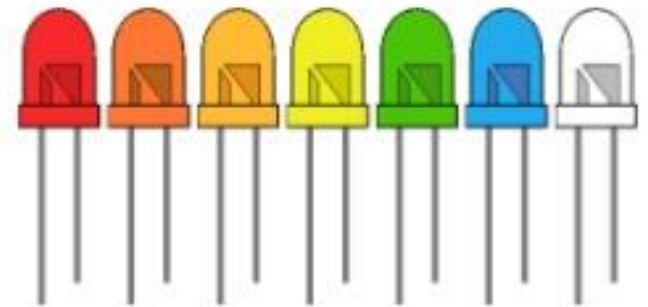
HOW DOES A LED WORK? (2/2)



- Each time an electron *recombines* with a positive charge, electric potential energy is converted into electromagnetic energy.
- For each recombination of a negative and a positive charge, a quantum of electromagnetic energy is emitted in the form of a photon of light with a frequency characteristic of the semi-conductor material

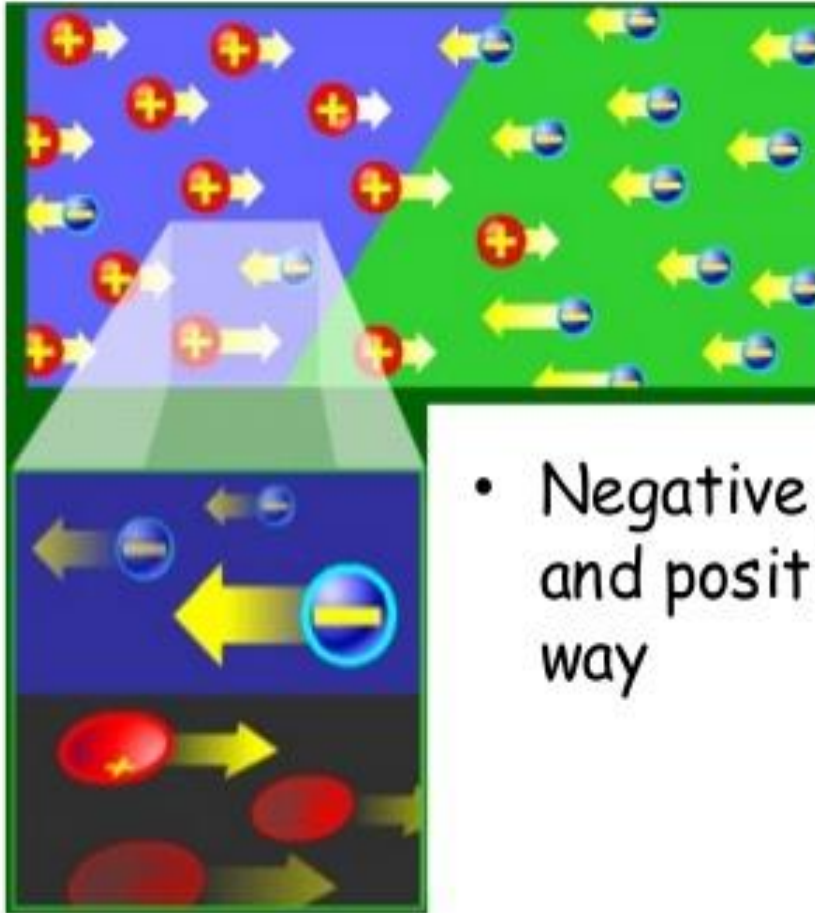
COLOURS OF LEDs (1/3)

- LEDs are made from gallium-based crystals that contain one or more additional materials such as phosphorous to produce a distinct color.
- Different LED chip technologies emit light in specific regions of the visible light spectrum and produce different intensity levels.



- LEDs are available in red, orange, amber, yellow, green, blue and white.

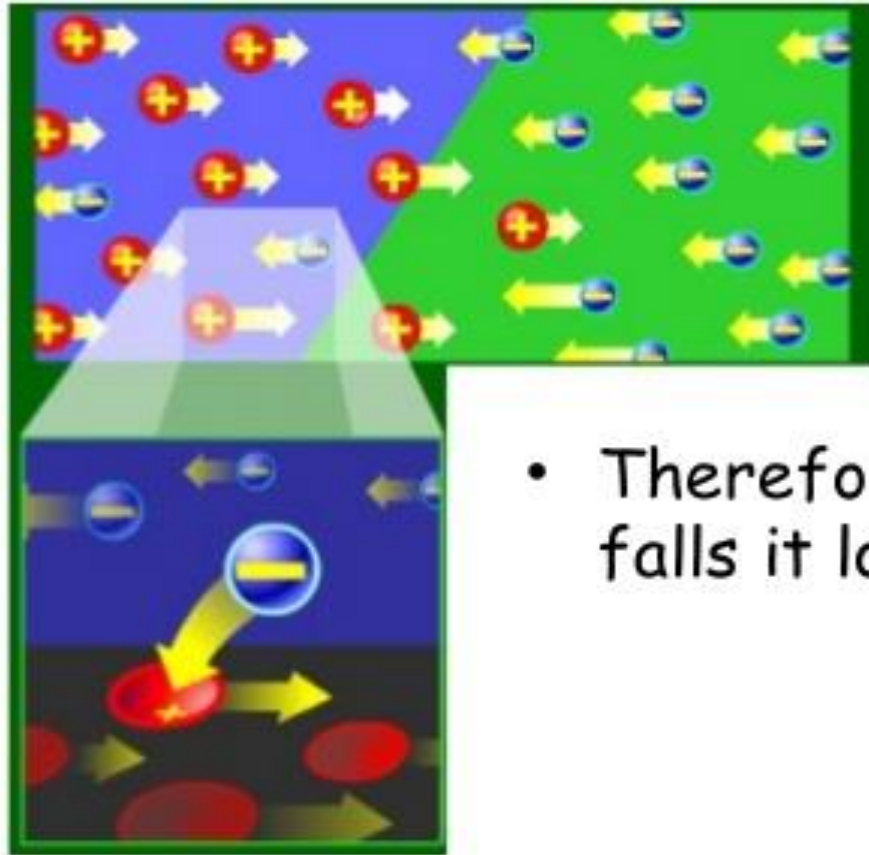
LED: How It Works



- When current flows across a diode

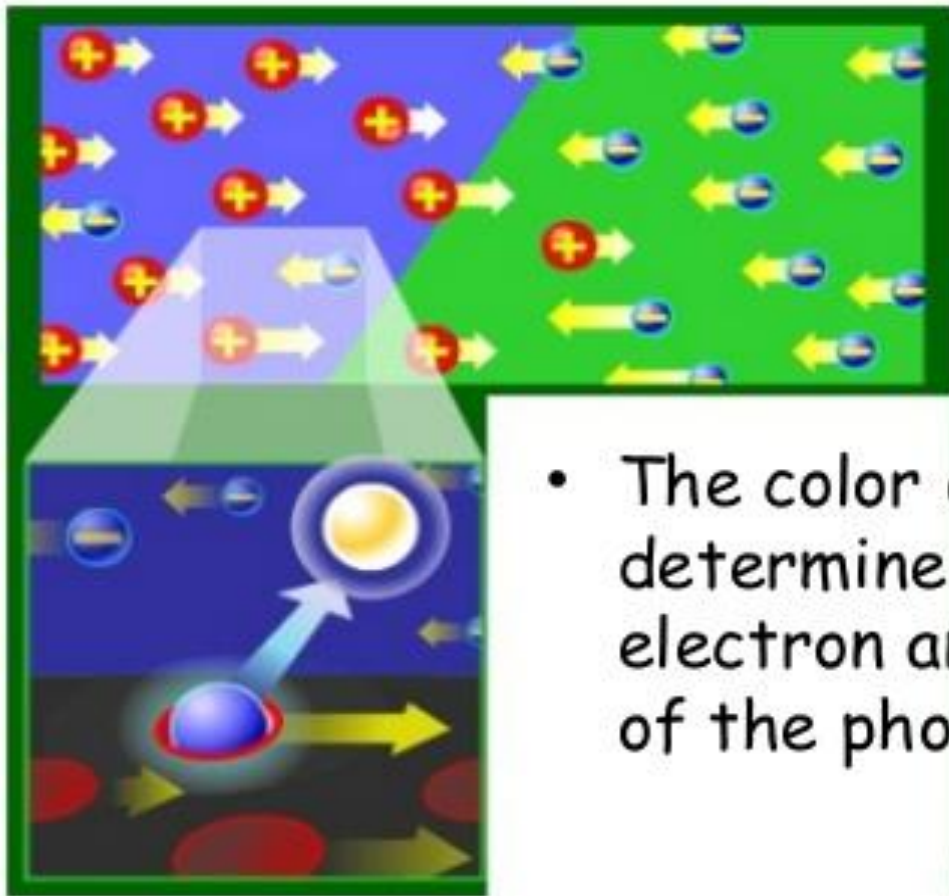
- Negative electrons move one way and positive holes move the other way

LED: How It Works



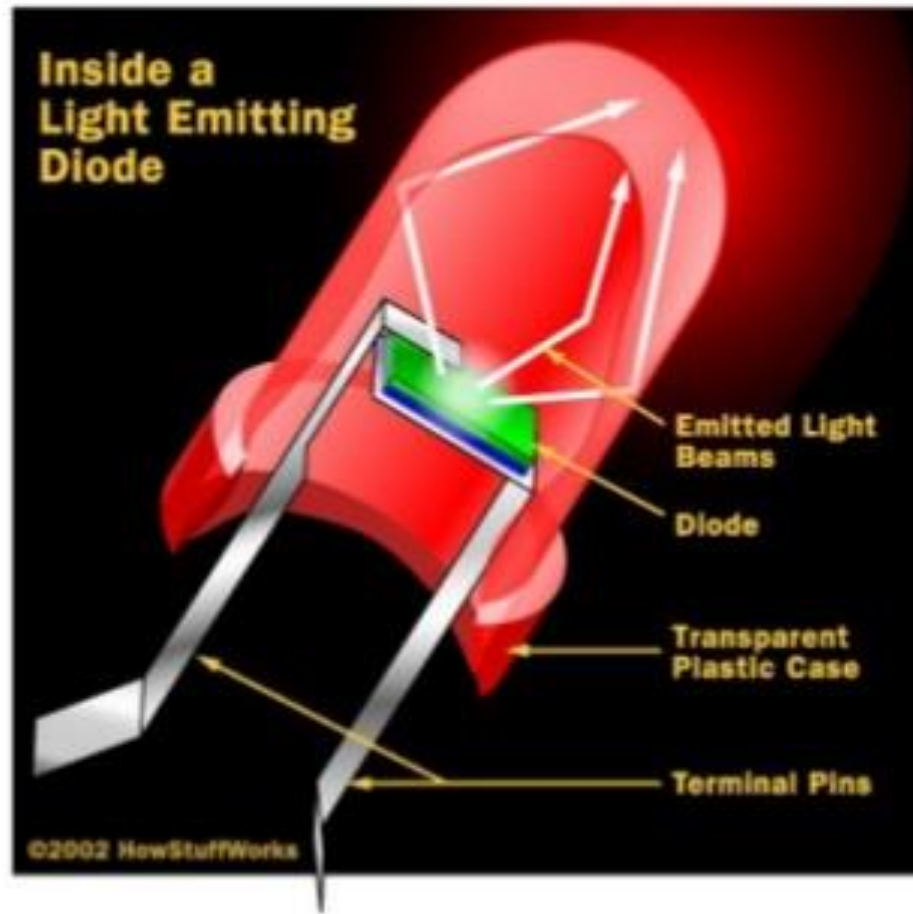
- The holes exist at a lower energy level than the free electrons
- Therefore when a free electrons falls it losses energy

LED: How It Works



- This energy is emitted in a form of a photon, which causes light

- The color of the light is determined by the fall of the electron and hence energy level of the photon



1. Transparent Plastic Case
2. Terminal Pins
3. Diode

Some Types of LEDs



Bargraph



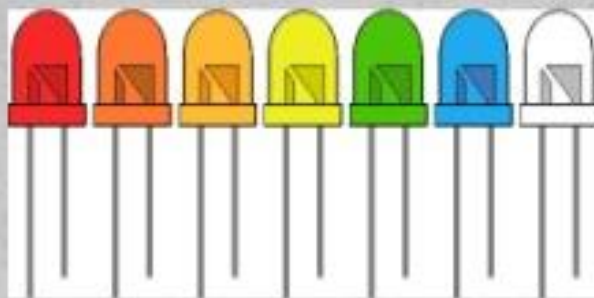
7-segment



Starburst



Dot matrix



Applications

- Sensor Applications
- Mobile Applications
- Sign Applications
- Automotive Uses
- LED Signals
- Illuminations
- Indicators

Applications of green LEDs



Fig. 1.11. Green traffic signals are one of the ubiquitous applications of GaInN / GaN green LEDs.



Fig. 1.16. LED display consisting of 18 million LEDs located in New York City.



Fig. 1.17. Pedestrian sign indicating number of seconds left to cross street located in Taipei, Taiwan.

- High-brightness LEDs for outdoor applications

