

Colors In The Screen: History and Improvements

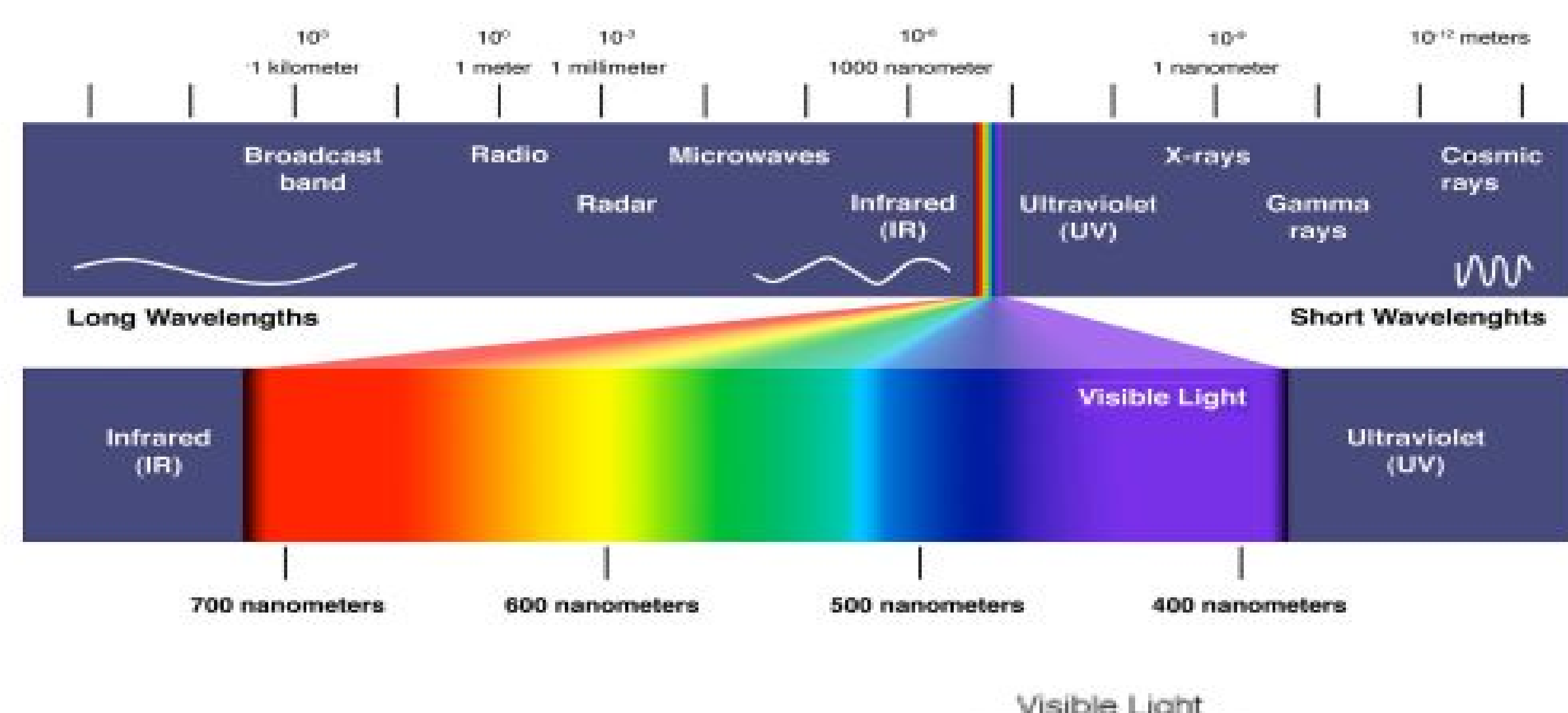
Rare Earth Elements and Light Emitting Diode

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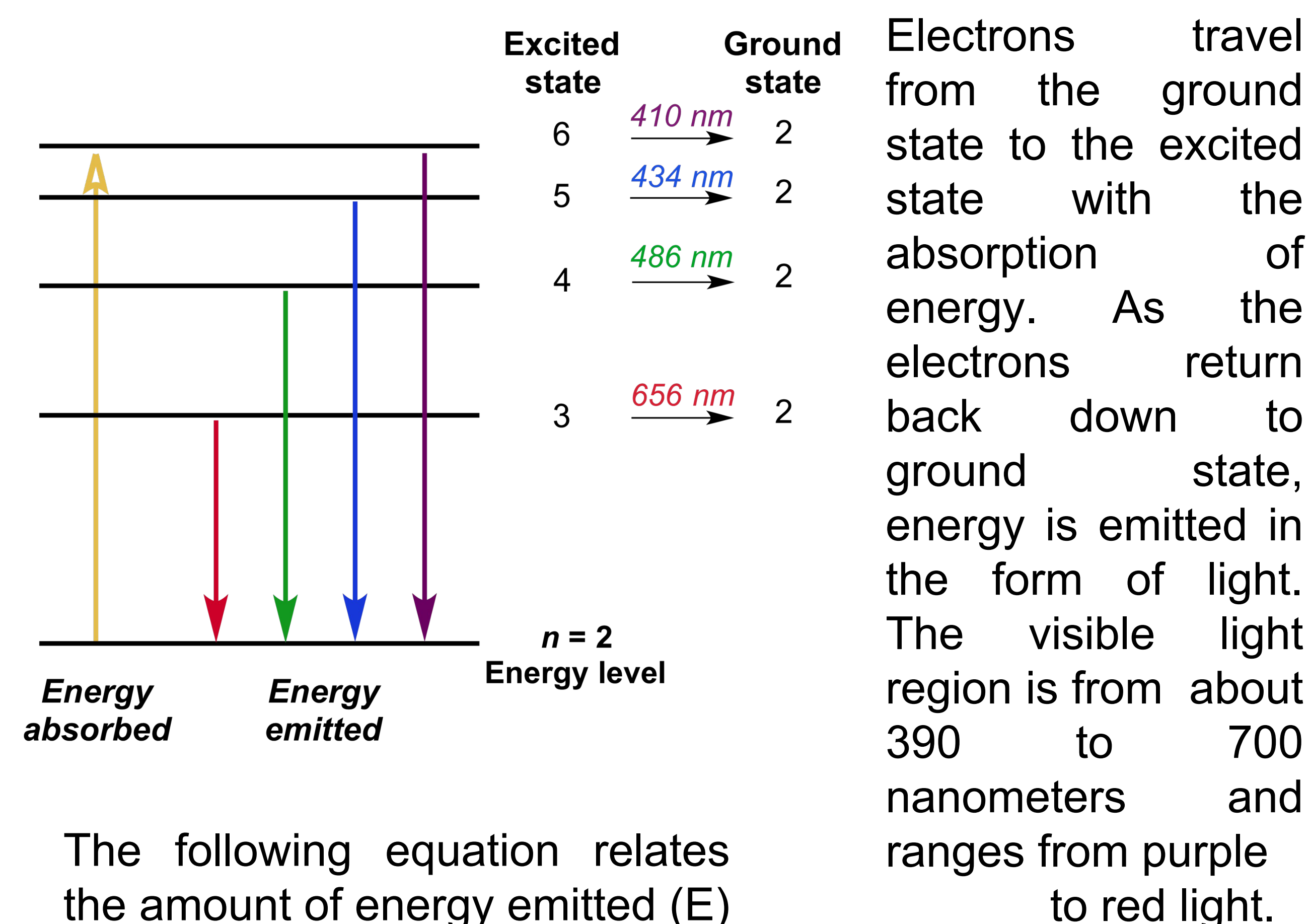
Abstract

A research project was conducted to determine the origin of colors within a screen on a smartphone and other varying pieces of technology. This study resulted in the discovery of one important chemical concept, rare earth elements (REE). The rare earth elements are composed of the elements on the periodic table in the lanthanide series along with yttrium and scandium. Out of this collection, specific REEs are used in combination or individually to produce phosphors (a substance which emits luminescence). Looking more in depth, the red, blue, and green light intensities combine at various levels to produce different colors in differing shades. Each specific component is composed of specified REEs within phosphors. The emission of specified colors is related to the concept of exciting electrons within the orbitals. The emission of energy in the form of light occurs with the electrons returning to their original orbitals. Also within the concept of LEDs semiconductors are used to control color appearance on a screen. There is a positive and negative type which both have differing roles when it comes to the movement of the electrons within the semiconductors.

Light Spectrum Chart



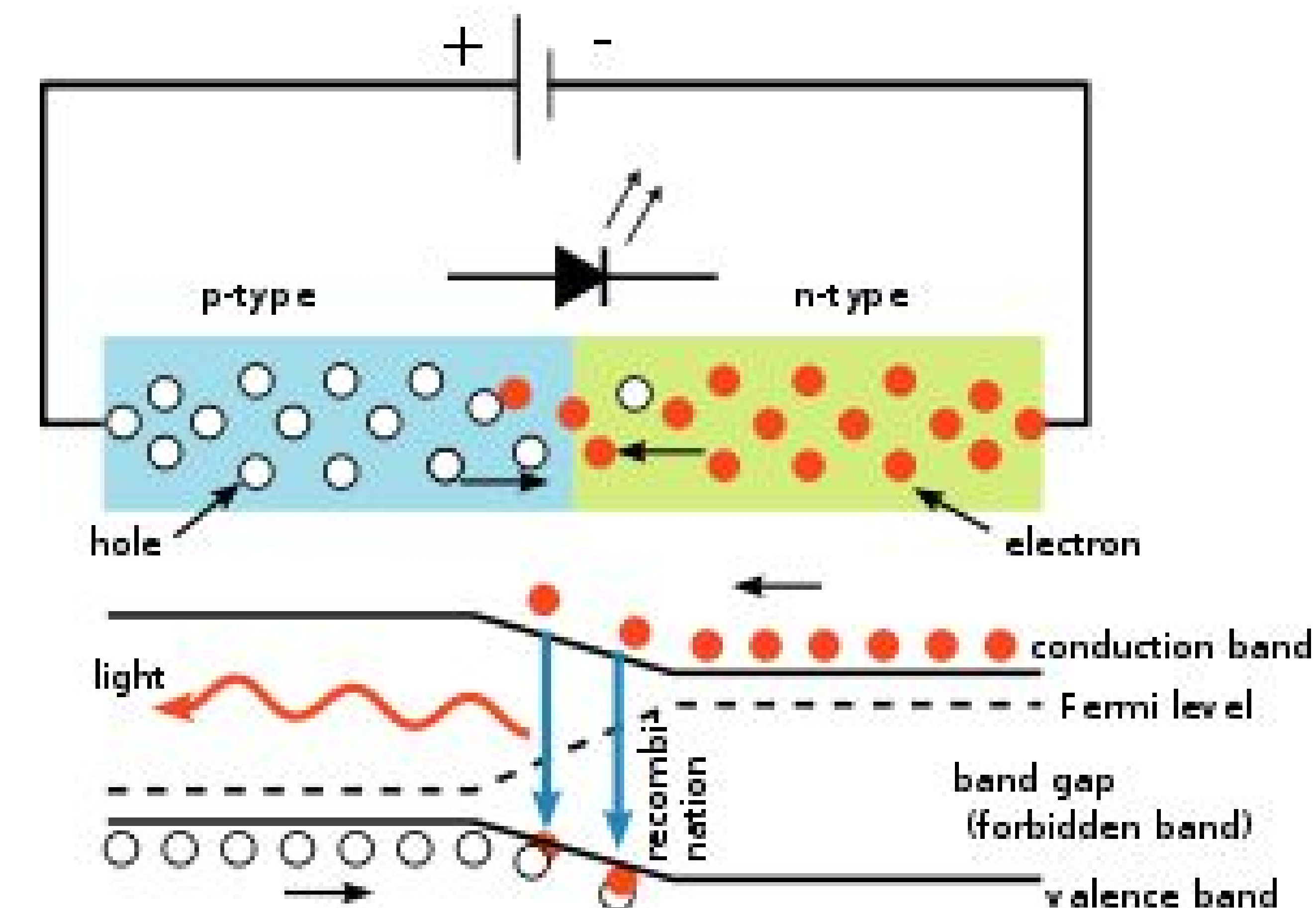
Principle: Energy Emission as Light



The following equation relates the amount of energy emitted (E) to the plank's constant (h), frequency (ν), and wavelength (λ).

$$E = h\nu = hc/\lambda$$

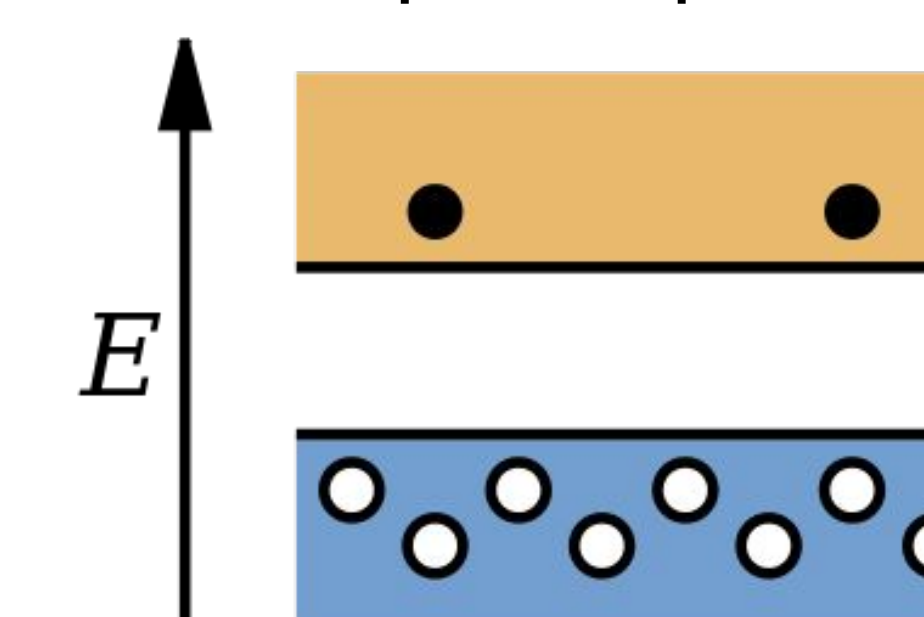
Semiconductor in LED



P-N junction, which is a boundary between different type (P&N) semiconductors, is used in LED. These semiconductors are 'doped', so the band gap and conductivity can be controlled.

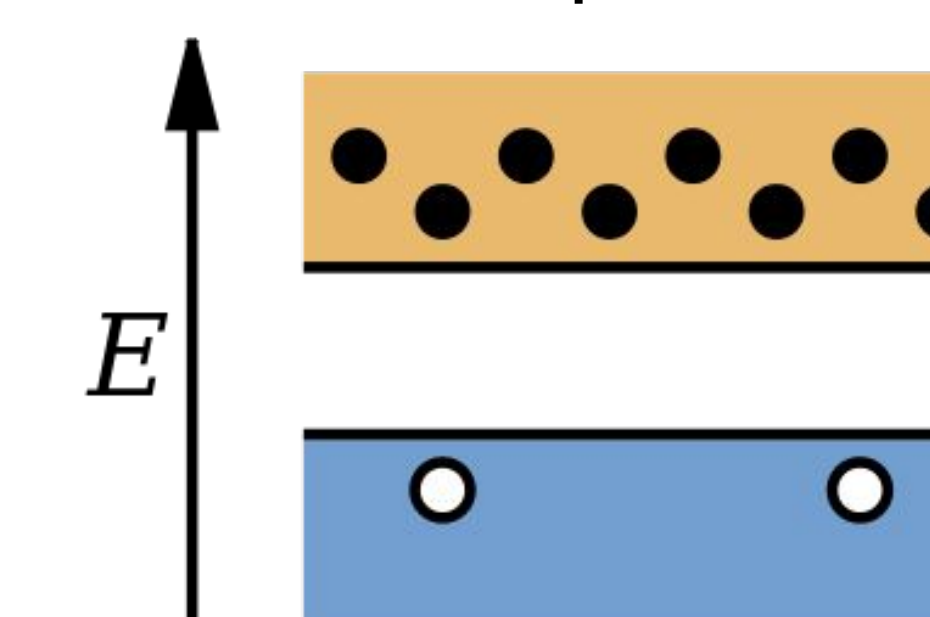
P type (positive)

- Holes as a carrier
- Acceptor impurities



N type (negative)

- Electrons as a carrier
- Donor impurities



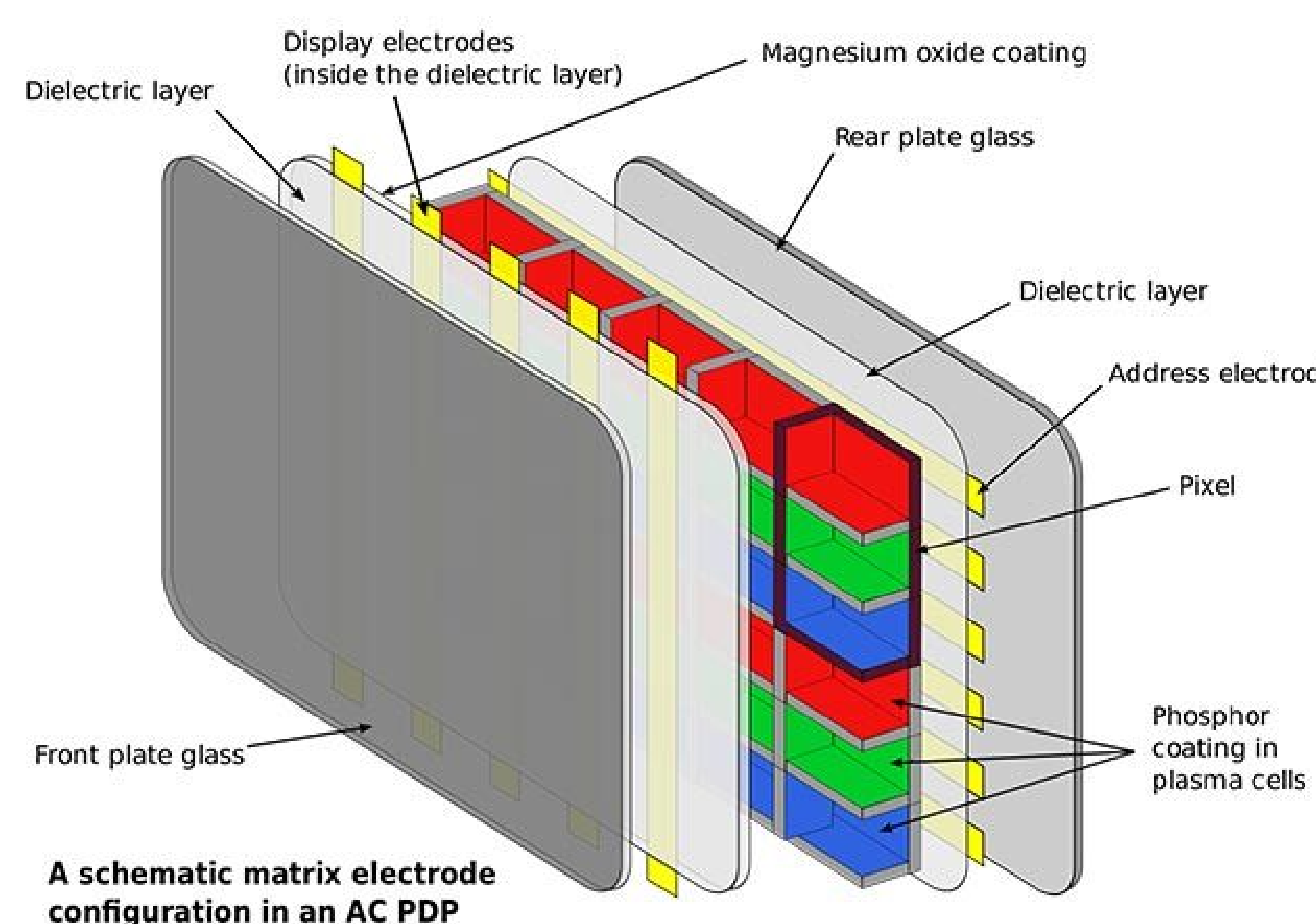
Rare Earth Elements (REE)

Rare Earth Metals are classified as the elements in the lanthanide series along with yttrium and scandium.



Specific REEs are used individually or in combination to emit luminescence in specific colors.

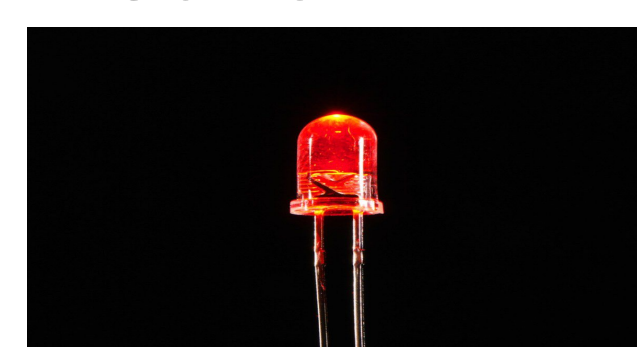
- Red: Yttrium & Europium
- Green: Terbium
- Blue: Europium



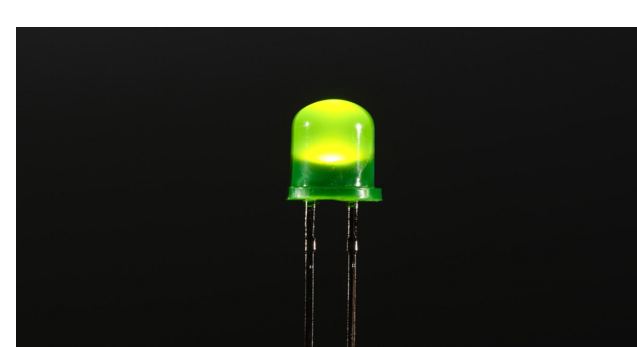
How Colors have been Shown on LED

LEDs gained popularity after all 3 colors of light were developed and commercialized. However, it is more difficult to find semiconductors for lower wavelengths.

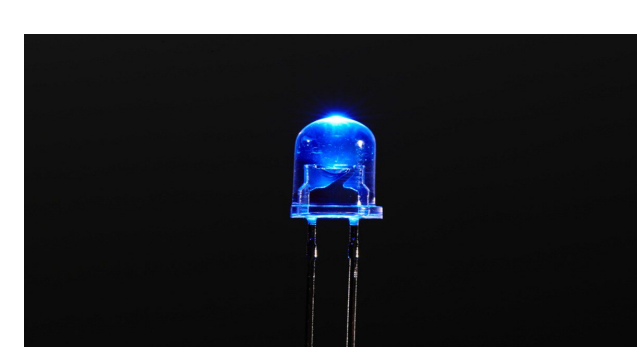
Red LED
- 1968, N. Holonyak
- GaAsP



Green LED
- 1972, G. Craford
- ZnSe



Blue LED
- 1993, S. Nakamura
- GaN



Conclusion & Future Improvements

Rare earth elements and semiconductors play a vital role in the production of colors within a screen. In the future, scientist have been researching the improvement of resolution and color accuracy for display.

Reference

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