EIT RawMaterials is supported by the EIT, a body of the European Union

Educational Card: Europium

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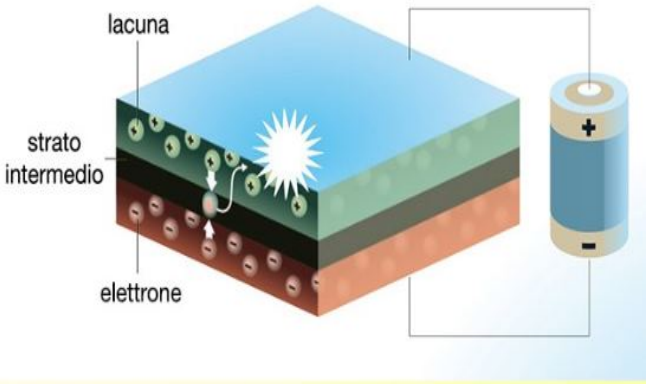
News:

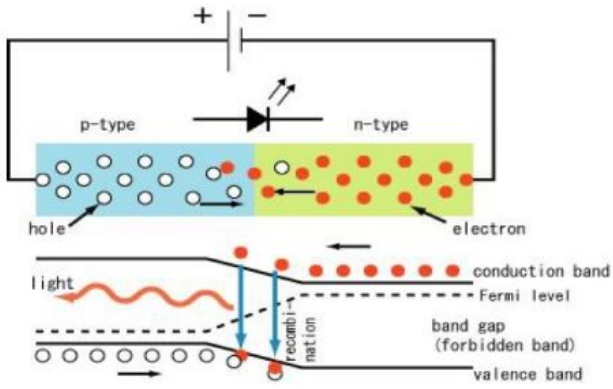
LEDs are gradually replacing old incandescent and neon bulbs. The revolution of Leds was mainly possible thanks to *Isamu Akasaki*, *Hiroshi Amano*, *Shuji Nakamura*'s studies. These three Japanese scientists won the Nobel prize for Physics in 2014.
Their researches have made possible to reduce the energy consumption for lighting.

In 2011 wide Rare Earth deposits were discovered in the Pacific Ocean. It is estimated these elements are so abundant on the bottom of the ocean that just one square kilometre could supply one-fifth of the current annual world consumption.

Functioning of LED:

A LED (Light Emitting Diode) is made of a semiconductor material divided into two layers each doped with different elements. The *n* region is doped with a element which has an electron more than the semiconductor, whereas the *p* region is doped with an element which has an electron less, so that there are some "*holes*". A "*hole*" is a site of the crystal lattice where there is a lack of an electron. The two poles *n* and *p* are connected to a battery which induces the electrons flow. When electrons pass from region *n* to *p* one, they emit a photon because there is a difference in energy between the electrons of the regions. The light of the LEDs is monochromatic - the energies and the wavelengths of the photons are always the same.





Use of Europium in LEDs:

Europium is fundamental for the realization of white-light LEDs. In fact white light does not exist in nature but it is obtained by mixing together blue, green and red radiations. Europium is a **phosphorus**, so it has the fluorescence property, that is it can absorb light radiation and emit it again with a greater wavelength.
Particularly, $\mathbf{Eu^{3+}}$ ion coverts a blue light in a red one whereas $\mathbf{Eu^{2+}}$ ion transforms it in green radiation.
Therefore, if we use a mixture of the two Europium ions, it is possible to transform the light emitted by a blue LED in white light.

How to recycle Europium:

Two methods are used to separate the various components inside LEDs.
The first consists in a *chemical bath* of the components in an acid aqueous solution. Recently it has been developed a faster, more economic and ecologic process in which the components are exposed to *UV rays*.

To RECYCLE means to re-use the single elements separated from the others components

How to Recover Europium:

The Rare Earths' recovery is currently possible only for some fluorescent lamps (the "ancestors" of LEDs). But the recovered material must be re-employed in the same type of lamps.
A proper technology to recover the phosphors used in white-light LEDs and in the backlight of LCD screams has not been developed yet.

To RECOVER means to re-use a complex component

Sources:

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