Radiation emitting device and manufacturing process thereof

INVENTORS: Barillaro Giuseppe
Strambini Lucanos Marsilio.

PATENT STATUS: GRANTED

PRIORITY NUMBER: MI2012A001364

GRANT DATE: 18/12/2014

Invention

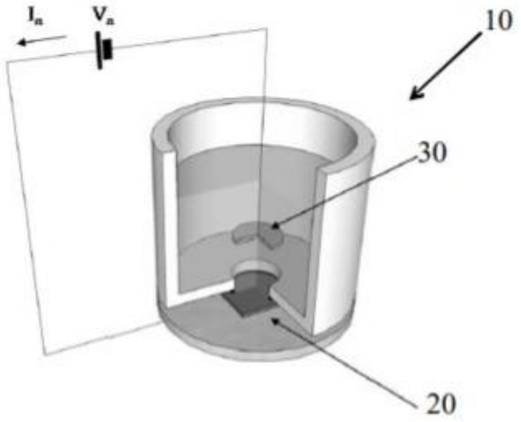
The present invention relates to an electromagnetic radiation emitting device, particularly in the visible spectrum. The emitting device is capable of **simply and effectively modifying the primary emission spectrum** of the device in order to obtain a final electromagnetic radiation of desired wavelength, different from the primary emission. The present invention further relates to a **method of manufacturing said device**, as well as to the use of a **converter material** suitable to realize said modification of the emission spectrum.

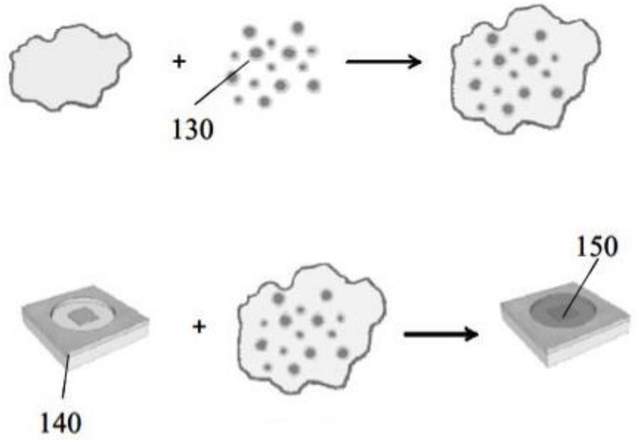
The device was born to meet the need to prepare a device emitting electromagnetic radiation of simpler realization than the devices known to the state of the art, ensuring the achievement of the desired optical properties, as well as a uniform and constant efficiency of conversion of the wavelength of the electromagnetic radiation of departure emitted by the layer of semiconductor material possessed by the device.

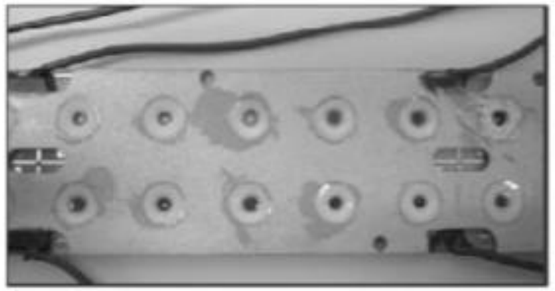
The studies have highlighted the need to associate the layer of semiconductor material with a converter layer - capable of performing the function of converting at least partially said electromagnetic radiation of departure - made of a different material than the phosphors and silicon nanoparticles of the production processes known and easier to process and simple conferral of optical properties (in particular photoluminescence) necessary for the emission of **electromagnetic radiation of the desired wavelength**. This was achieved by fabricating the converter layer of the emitting device in a **nano-structured silicon-based material**.

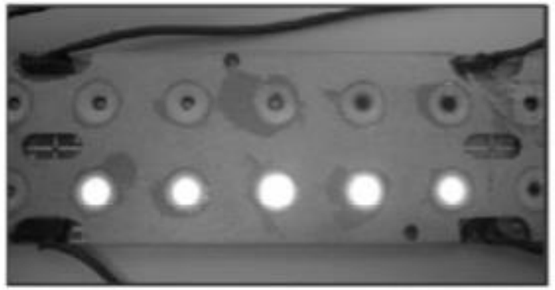
R.i.CO. - INDUSTRIAL AND COMMERCIAL REPRESENTATIONS S.R.L. is also a patent applicant.

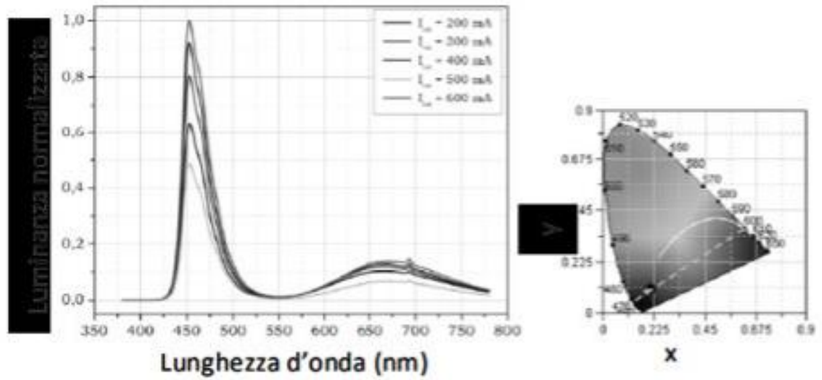
Drawings & pictures











Industrial applications

The emitting device according to the present invention may find application in all those fields where **a light source in the visible spectrum**, whether white or coloured light, **is required**, even where a small light source is required. A first example is represented by the lighting industry which may include:

- public or private lighting systems, both for indoor and outdoor use, where generally light sources characterized by high efficiency and low consumption (both in terms of energy saving and reduction of environmental impact) are required.
- luminous signage for means of transport, where coloured and well visible light sources are required even in difficult atmospheric conditions.
- artistic and architectural lighting systems, where versatile and easily configurable white or coloured light sources are required.
- artificial vision systems where bright, focused and homogeneous light is required.

A second example is the field of medicine, which can include:

- chromotherapy, where coloured light sources are required for the treatment of certain diseases.
- photo-biomodulation, where non thermal light sources are required that must not produce damage to the cells of the treated tissue.
- electromedical analysis equipment, such as the endoscope, where small light sources are required.

A further example is represented by the agricultural sector, where cultivation can be made more efficient by selecting for each type of crop the light source having the appropriate wavelength and emission band.

Possible developments

The invention makes it possible to define and predetermine in a single process step **both the fundamental wavelength and the emission band of the electromagnetic radiation** emitted by the device. In detail, by varying the intensity of current applied, it is possible to vary the size of nano-structured silicon crystals and, therefore, to select in a single process step both the fundamental wavelength and the emission band of the electromagnetic radiation emitted by the device. This aspect is particularly advantageous both in terms of **versatility of the production process** and in terms of **costs** of the latter and, therefore, also the cost of production of the device itself.

Moreover, the above production process has a good reproducibility and an efficient use of the starting silicon because, once removed the membrane of nano-structured silicon obtained in this way, the remaining crystalline silicon substrate can be reused to form a new membrane allowing the use of the substrate for its entire thickness **with a significant reduction of production waste**. In addition, the dimensions of the membranes and microparticles of nano-structured silicon are such as to **simplify the assembly of the final emitter device** and is guaranteed **a greater stability of the properties of the emission spectrum** of light emitted from the device.

Five prototypes of the invention have been developed and are in the testing phase.

For more information:

Tech Transfer Office of University of Pisa

Headquarters: Lungarno Pacinotti 43/44, Pisa (PI) 56126

Web site: www.unipi.it/index.php/trasferimento

E-mail: valorizzazionericerca@unipi.it

For more information:

Ufficio Regionale di Trasferimento Tecnologico

Headquarters: Via Luigi Carlo Farini, 8 50121 Firenze (FI)

E-mail: urtt@regione.toscana.it