MASTER in PHOTONICS
EUROPHOTONICS - POESII

MASTER THESIS PROPOSAL

Course 2015 –2016

Laboratory: IREC-Catalonia Institute for Energy Research. Lighting Group.
City, Country : Sant Adrià de Besòs, Spain

Title of the master thesis: Polychromatic LED-engine based on remote organic phosphors

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Summary of the subject (maximum 1 page) :

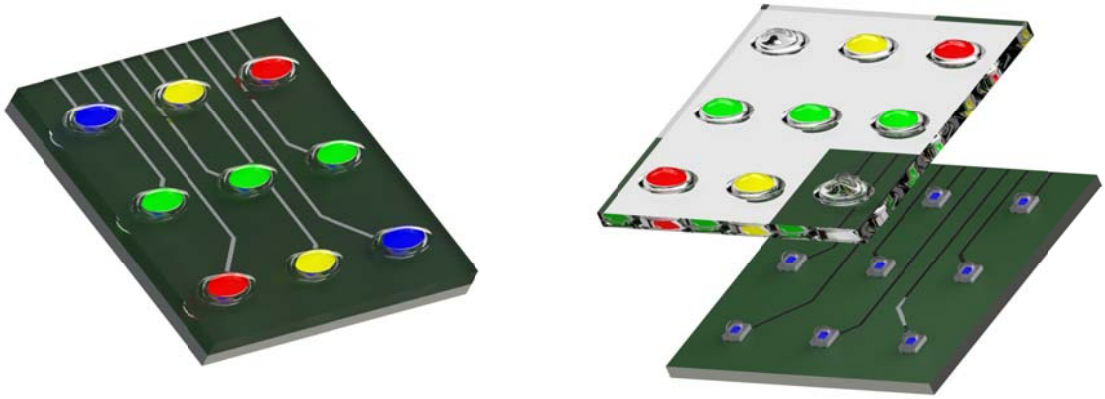
Phosphors used in mainstream PC-LED (Phosphor-converted LED) technology are typically inorganic, comprising most of them a crystalline oxide, nitride, oxynitride or silicate host lattice, doped with a small dose of an activator ion, in most cases rare earths. These activators ions have intrinsic characteristics that contribute to the optical properties but the host matrix ultimately determine the phosphor characteristics, depending on how much screened are from the lattice the energy levels involved in the optical transition. In SSL Ce^{3+} and Eu^{2+} are the activator ions more broadly used and it is just here where it is foreseen that PC-LEDs can have a potential weakness in the next decade.

Rare earth materials are a critical component for LED technology since the global shortage of these materials is currently having a direct impact on phosphor availability and pricing. After DOE (Department of Energy, US), Europium could be in short supply as soon as 2015, while in the case of Cerium, the stocks are under moderate risk. In the light of this, it is clear the necessity of new approaches and materials capable of replacing in the next future these rare-earth based phosphors, thereby overcoming the availability risks and potential cost overruns.

To overcome this, we are investigating innovative organic phosphors, potentially cheaper since they are based on abundant elements and whose emission can be easily tuned along the whole visible range. These organic materials have been tested by depositing them directly on blue LED-dies with very promising results. Unfortunately, due to the relatively high temperatures at the die level, phosphors degrade and so does the performance. In order to

solve this, the implementation of remote phosphor conversion system appears to be a suitable solution.

The core of the work is the implementation of a polychromatic LED-engine for lighting purposes taking advantage of the emission of these organic phosphors. The LED engine will be composed of different channels distributed along the visible range, any of them based on one particular phosphor (i.e. wavelength). The phosphors will be pumped by conventional UV/blue LEDs and will be subjected to intelligent control strategies that will provide with spectral reproduction capabilities. The system will be completed with an external optic system conceived as mechanical support for phosphor deposition, optimum colour mixing and final beam shape.



Schematic drawing of device proposed

Keywords : LED Lighting, phosphor converted LED, remote phosphor, spectral reproduction, color quality and intelligent lighting.

Additional information:

* Amount of the monthly allowance (if it is the case):

* Required skills: Mechanical design, Optical design, ray-tracing software, background in LED physics, material science, lighting, radiometric and photometric quantities, colorimetry and PCBs.

* Miscellaneous : Commitment, teamworking and autonomous working.