New generation of lanthanides-free phosphors for white LEDs lighting prepared by the polymeric precursor method

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Solid-state lighting (SSL) using light emitting diodes (LEDs) is recognized as a major disruptive technology expected to dominate the public lighting market in the near future. The main advantages of SSL sources are the energy saving (50 % compared to typical lighting devices), their potential stability to produce long lifetime devices, and the possibility they offer to develop smart lighting devices. At Néel Institute, we develop [1,2] a new type of phosphors based on metal aluminum borate powders without any lanthanide as doping. These innovating phosphors can produce broad emission bands extended in the whole visible range from emitting centers (structural defects) trapped in stable glassy grains of a few microns in diameters. Thus, from only one phosphor excited with a near-UV LED chip (UV (365- 390 nm), we can generate intense warm white light: internal quantum yields around 80-90% and very high color rendering indexes (CRI = 92-94) have been obtained. A low-cost near-UV LED is further developed at LMGP, based on the heterojunction of an array of n-type ZnO nanowires on p-type GaN. Eventually, the coupling of the two components as a **new generation of eco-efficient white LEDs** will be optimized and integrated in one Solid State Device.

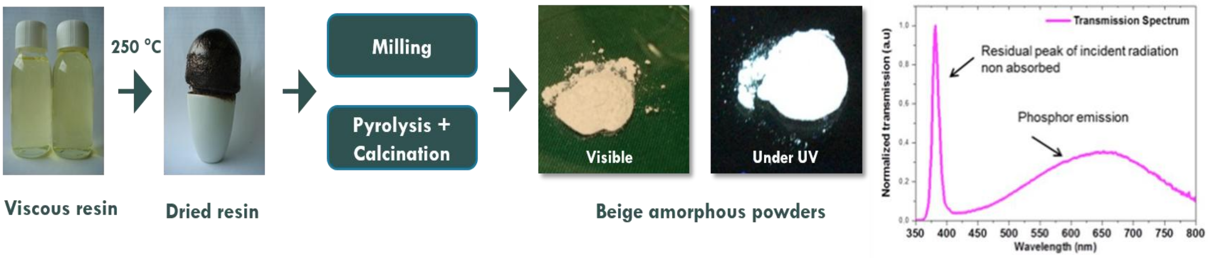

Figure 1. The step process: resin, after drying at 250°C, pyrolysed black powder and luminescent powder after a final calcination. Broad PL emission of the phosphor from 450 to 800 nm and residual near UV incident radiation of the LED chip (365 nm).

The main objective of this study is to optimize the chemical compositions, synthesis procedures, and thermal treatment conditions for these micrometric powders to enhance their luminescence properties. This is favoured by the great versatility of wet chemistry process, such as polymeric precursor methods. Complementary spectroscopic studies (EPR, NMR, FTIR, PL) and structural methods (X-ray Diffraction, Pair Distribution Functions (PDF), NMR, coupled with thermal analyses (DSC, DTA) - Thermogravimetry (TG) - Mass Spectrometry (MS)) are used to specify the chemical nature and structural environment of emitting centers.

[1] V.F. Guimarães, L.J.Q. Maia, I. Gautier-Luneau, C. Bouchard, A.C. Hernandes, F. Thomas, A. Ferrier, B. Viana, A. Ibanez, J. Mater. Chem. C. 3, 5795 (2015).

[2] V.F. Guimaraes, M. Salaün, P. Burner, L.J.Q. Maia, A. Ferrier, B. Viana, I. Gautier-luneau, A. Ibanez, Solid State Sci. 65, 6 (2017).