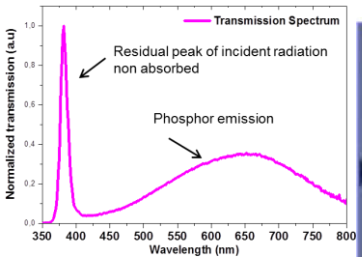
NÉEL INSTITUTE Grenoble

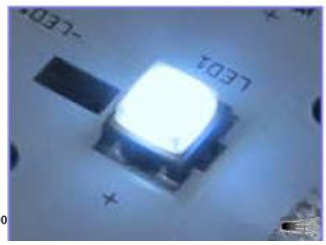
Topic for Master 1 & 2 internship – Academic year 2016-2017

New generation of phosphors for LED lighting

General Scope: Lighting by "white LEDs" has become a major challenge for energy saving. However, several problems need to be overcome, the most important are: cost, quality of the white photoluminescence emission and thermal stability. Currently, all devices used, or in development, involve rare earth ions whose main drawbacks are lighting with narrow emission bands with a significant blue component and also their high cost as they are highly strategic elements due to the monopoly of their production by China. At the Institut Néel, we develop a new type of phosphors based on vitreous powders to achieve white LEDs for solid lighting. The innovative character of these aluminoborate phosphors is to produce a broadband luminescence emission throughout the visible spectrum, from color centers (structural defects) in an amorphous matrix. In addition, these phosphors are made of non-toxic and abundant, no rare earth thus making them much less expensive. The project is the pursuit of original work (thesis and patent), which has been initiated in recent years.

Research topic and facilities available: The aim of this stage are firstly: - Understanding the origin of the emitting centers, which are related to structural defects (oxygen radicals, carbon interstitials...) in order to optimize the luminescence properties. The optimization of the synthesis of these phosphors will be performed by "chimie douce" (sol-gel, Pechini), varying chemical factors (nature and stoichiometric ratios of molecular precursors which allow the metal complexation and the polymerization of organic-inorganic network) - change the chemical composition, which should allow you to adjust the width of the spectral emission of luminescent for better colorimetry. A study of the different parameters of thermal treatments (heating rates, the ranges of temperature, controlled atmosphere during treatment), which are at the origin of the presence of emitting centers and the control of grain size, should be clarify. Finally, the understanding of the origin and role of emitting centers and the structural characterizations and modeling of the amorphous phase will be implemented by coupled spectroscopic studies: FTIR, UV-Vis spectroscopy, EPR, NMR, X-ray diffraction and X-ray scattering.





Left) emission spectrum of powder showing a residual peak of the UV incident radiation, non-absorbed by the phosphor, and the broad PL emission band of the phosphor in the whole visible range, between 400 and 800 nm leading to good color coordinates- Right) first lighting prototype involving a NUV-LED and the aluminoborate powder dispersed in a silicone matrix

Possible collaboration and networking: Institut de Recherche Chimie-Paris ; INAC-CEA Grenoble
Possible extension as a PhD: Yes
Required skills: Chemistry in solution, basic knowledge on physicochemical and structural characterizations of material

Contact :
Pr Gautier-Luneau Isabelle
Institut Néel – CNRS
Phone: 04 76 88 78 04 e-mail: Isabelle.Gautier-Luneau@neel.cnrs.fr/
More information: http://neel.cnrs.fr