Laboratoire Hubert Curien
UMR CNRS 5516 Université Jean Monnet SAINT-ETIENNE

PostDoc proposition (18 months)

Topic

Simulation of the luminescence of structured surfaces for application in LED lighting (ANR project SMARtLEDs)

Partners

Groupe Matériaux Luminescents de l'Institut de Chimie de Clermont-Ferrand (ICCF) / Sigma Clermont - Université Clermont Auvergne

Groupe Chimie Liquide et Fonctionnalisation de Surface du Laboratoire des Matériaux et du Génie Physique (LMGP) - Institut Polytechnique de Grenoble

Groupe Réseaux de Diffraction du Laboratoire Hubert Curien (LabHC) - Université Jean Monnet, Saint-Etienne

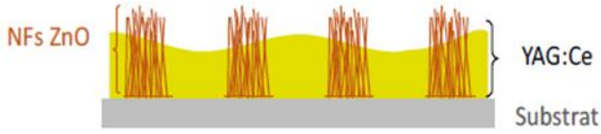
The Postdoc will be working mainly at LabHC, with regular interaction with the other project partners.

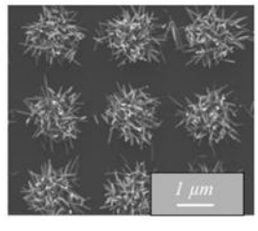
Context of the PostDoc

The SMARtLEDs project associates three laboratories of the Auvergne-Rhône-Alpes region (ICCF, LabHC, LMGP) and addresses the field of LED lighting. White lighting devices currently on the market use blue LEDs associated with phosphors, emitting in the yellow and red spectrum. This combination often offers only a limited range of colors with an insufficient Color Rendering Index (CRI), with the lack of emission in the red (620 nm < < 720 nm) being the main reason. There is a thus a need for improvement, by controlling the emission at the spatial and spectral levels. In SMARtLEDs, coatings of YAG:Ce3+ associated with nanowires of ZnO organized in the form of periodic gratings are proposed to improve light extraction and improve the required red component, replacing other expensive or not yet stable enough solutions currently employed. The YAG:Ce3+ and ZnO structures will be elaborated via low cost sol-gel solutions.

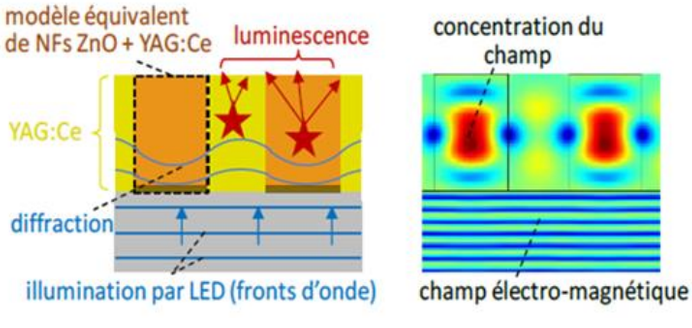
Subject of the PostDoc

One considered setup is sketched in the adjacent figure, with other variants of the shown combination of YAG:Ce and ZnO nanowires also possible. The goal is to simulate the spectral and angular characteristic of the luminescence of the whole system.





In a first step, the system can be considered as indicated in the adjacent figure. The filed created by the illumination with blue light can be calculated by rigorous optical simulation (RCWA, Chandezon), using simplified models of the materials and geometry. The emission is then modelled based on this field distribution by calculating the effect of emitting dipoles representing the materials fluorescence in response to the illumination, using rigorous methods like FDTD. The results will be compared with experimental results, in order to confirm and estimate the precision of the method. In further steps a complete modelling of the structures, incorporating also interdependent effects (e.g. back conversion) is planned, by developing rigorous methods that take both steps of illumination and luminescent emission into account.



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