

# PHOTODEGRADATION OF LUMINESCENT ETHYLENE-VINYL ACETATE/INORGANIC PHOSPHOR COMPOSITES FOR APPLICATION AS MULTIFUNCTIONAL COATING OF ORGANIC SOLAR CELLS

Anthony Perthue<sup>1,3</sup>, Sandrine Therias<sup>1,3</sup>, Jean L. Gardette<sup>1,3</sup>, Damien Boyer<sup>2,3</sup>, Philippe Boutinaud<sup>2,3</sup>

<sup>1</sup>*Clermont Université, Université Blaise Pascal, Institut de Chimie de Clermont-Ferrand, BP 10448, F-63000 Clermont-Ferrand*

<sup>2</sup>*Clermont Université, ENSCCF, Institut de Chimie de Clermont-Ferrand, BP 10448, F-63000 Clermont-Ferrand*

<sup>3</sup>*CNRS, UMR 6296, ICCF, BP 80026, F-63171 Aubière  
(anthony.perthue1@etudiant.univ-bpclermont.fr)*

Efficiency and lifetime of organic solar cells (OSC) are two bottlenecks for their massive industrial development.

A multifunctional encapsulation could improve both efficiency and lifetime by increasing the conversion efficiency of the cell and limiting the oxygen and water diffusion toward the active layer.

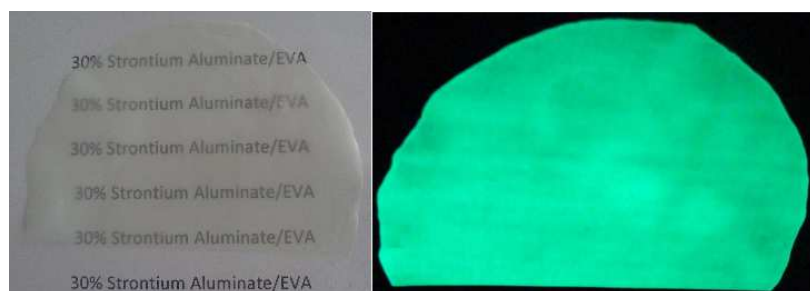
In this work, photodegradation of composite films made of ethylene-vinyl acetate copolymer (EVA) and micrometric particles of luminescent strontium aluminate  $\text{SrAl}_2\text{O}_4$  (SA) was studied. The targeted application of these composites is the multifunctional encapsulation of OSC.

The SA particles were doped with  $\text{Eu}^{2+}$  for obtaining a down-conversion effect resulting from the absorption of high energy UV light and then an emission of lower energy visible light at 520 nm (figure 1).

The luminescent SA material was chosen for its spectroscopic properties, permitting SA to be excited in the UV solar domain and giving a good spectral overlapping of its emission with the absorption of poly(3-hexylthiophène) (P3HT), which is a reference in the field of OSC.

Films of composites with SA amounts from 10 to 30% w/w were prepared by extrusion and pressed to obtain films of thickness at about 50 $\mu\text{m}$ . These samples were characterized by FTIR and UV-visible spectroscopy.

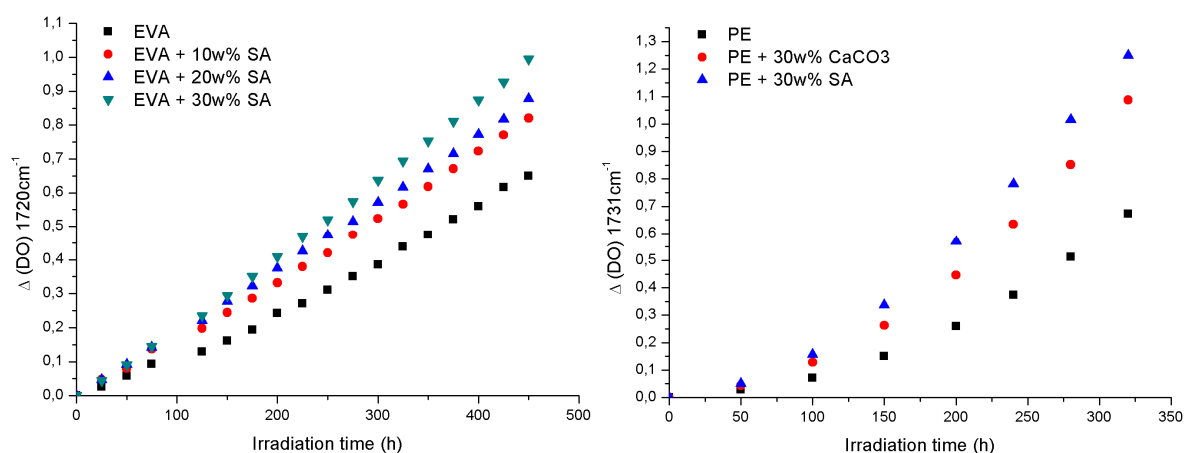
Artificial accelerated photoageing at  $\lambda > 300$  nm in presence of oxygen was performed at a temperature of 60°C.



**Figure 1** Composite films of EVA with 30% of SA ; in room light (left) and under UV 365 nm light (right)

The kinetics of photo oxidation of the EVA composites are shown on Figure 2. The oxidations rates of EVA composites were slightly higher than those of pristine EVA. This effect could be explained by the light scattering induced by the SA particles which increase the effective optical path in the irradiated films.

In order to check that the increase of the photooxidation rate was not coming from an increase of the local temperature caused by the absorption of the SA, we have also exposed composites of polyethylene (PE) and  $\text{CaCO}_3$ , this last being chemically inert and totally reflective. The same increase in the photooxidation rate was observed. This increase reflects the light scattering properties of the filler related to the size and nature of the particles. Complementary experiments on the role played by the size and shape of the filler are on-going.



**Figure 2** Variations of absorbance as a function of irradiation time : at  $1720\text{ cm}^{-1}$  for EVA composites films with 0, 10, 20, 30% of SA (left) ; and at  $1731\text{ cm}^{-1}$  for PE composites films with 0, 30% of SA and  $\text{CaCO}_3$  (right).