INFLUENCE OF FUNCTIONAL NANOPARTICLES ON THE PHOTOSTABILITY OF POLYMER MATERIALS: RECENT PROGRESS AND FURTHER APPLICATIONS

Sandrine Therias [a,b]

[a] *Clermont Université, Université Blaise Pascal, Institut de Chimie de Clermont-Ferrand, Equipe Photochimie, BP 10448, F-63000 Clermont-Ferrand, FRANCE*

[b] *CNRS, UMR 6296, ICCF, Equipe Photochimie, BP 80026, F-63171 Aubière, FRANCE,.fr*

The polymer-nanoparticles/nanocomposites have been the exponentially growing field of research for developing the materials in last few decades. Research has mainly been focused on processing and properties of the materials. Inorganic nanoparticles have become attractive since they can simultaneously improve the physical, mechanical and flammability properties. Among various nanoparticles, clay minerals and carbon nanotubes were more often used, but functional nanoparticles were also incorporated into polymer as "nano-additives". Depending on practical applications, nanoparticles of metal oxides (ZnO, TiO_2) were added for their photocatalytic and/or UV-screen effect. Luminescent oxides such as yttrium garnet ($YAG:Ce^{3+}$) were mixed with polymers (figure 1) for eco-energetic light devices.

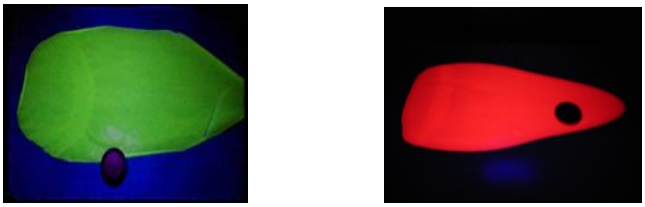

Figure 1.: Photos of polymer /phosphor nanocomposite films under UV excitation

Depending on their functionality—, nanoparticles can impact the durability of the nanocomposite materials[1] under UV –light exposure. The behaviour of various types of nanocomposites submitted to UV-light

exposure in presence of oxygen has been investigated and recent progress on the influence of functional nanoparticles on the polymer photodegradation will be presented.

Attention was firstly focused on the fate of nanocomposites with several polymers (PE, PP, EPDM, PS, epoxy …) and different nanofillers such as organo-montmorillonite[2] carbon nanotubes (NTC)[3] or Layered Double Hydroxides (LDH)[4]. Nowadays, montmorillonite is known to decrease the durability of polymer nanocomposites, whereas the effect of LDH or carbon nanotubes can be tuned. Stabilization of polymer/clay nanocomposites is then a bottleneck for industrial development of durable nanocomposites.

In the case of functional nanoparticles such as ZnO, TiO_2 or phosphors, one has to face two major questions:- i) what is the influence of the polymer degradation on the functional properties of the nanoparticles ii) do the nanoparticles impact the photostability of the polymer? The photochemical behaviour of nanocomposites will be explained with peculiar attention given to the influence of each component (UV absorber, photocatalytic particles and phosphors) on the rate of degradation of the polymeric matrix[5].

1. Kumar A.P., Depan P., Singh Tomer N., Singh R.P., Progress in Polymer Science, 34:479-515, 2009.
2. Morlat S., Mailhot B., Gonzalez D., Gardette JL, Chem. Mater.,16(3):377-383, 2004.
3. Morlat-Therias S., Fanton E., Gardette J.L., Peeterbroeck S., Alexandre M., Dubois Ph., Polym. Degrad. Stab.. 92:1873-1882, 2007.
4. Leroux F., Meddar L., Mailhot B., Morlat-Therias S., Gardette JL, Polymer, 46(11):3571-3578, 2005.
5. Grigoriadou I., Paraskevopoulos K.M., Chrissafis K., Pavlidou E., Stamkopoulos T.G., Bikiaris D., Polym. Degrad. Stab., 96:151-163, 2011.