Theoretical and experimental investigations of polymer photodegradation process to the viability analysis of radiation sensor for neonatal phototherapy

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Optical properties of luminescent polymers have been studied since the first report of electroluminescence in *poly(p-phenylenevinylene)* (PPV) in 1990. These materials are commonly employed in light-emitting displays because of their good processability, lightweight and higher luminance with low power consumption. However, the performance of these devices is limited by high susceptible to photodegradation processes which dramatically reduce the quantum efficiency and the lifetime of their devices. The changes in photoluminescence and absorbance spectra caused by visible radiation reflects the possibility to design and develop sensors where the effects of visible radiation on the optical properties of luminescent polymers are more important than improving the luminance and lifetime of the light-emitting devices made from them. Moreover visible sensors are desired especially in medical applications where blue-light phototherapy is used, for example, in neonatal disease treatments where exists a strong relationship between the rate of decline in serum bilirubin level of infant's skin and the intensity and spectral qualities of the light source, as well as the distance between the light source and the neonates. In this work we investigated the changes on the optical behavior of *poly(2-metoxy-5(2'-ethylhexyloxy)-p-phenylenevinylene)* (MEH-PPV) systems under the effect of blue-light radiation (460 nm focus, 40 $\mu W/cm^2$). We have also developed a model for MEH-PPV photodegradation based on structural changes of PPV derivatives oligomers in vacuum, in chloroform and in toluene solvents. It is observed changes from orange-red to yellow clearly on polymer systems, while its peak position emission shifts from orange-red to blue and decrease in intensity with increasing radiation exposure time. Our theoretical calculations were carried out on degradation structural models in which the effects the conjugation length. The results indicated that the inclusion of oxygen within the polymeric chain can produce significant blue shift in the absorption spectra, with associated decreasing in the intensity of the absorption spectra and in excellent agreement with the available experimental data. These results are very useful for maximizing the sensibility and specificity of a MEH-PPV as active material for blue-light sensors applied in neonatal phototherapy.

Keywords: OLED, hyperbilirubinemia, jaundice, semiconducting polymer, photoxidation

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