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DESIGN OF A VERSATILE AND LOW COST ORGANIC DOSIMETER FOR USE IN NEONATAL PHOTOTHERAPY

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Abstract – We report on the use of poly[2-methoxy-5-(2'-ethyl-hexyloxy)-1,4-phenylene vinylene] – MEH-PPV and aluminum-tris(8-hydroxyquinoline) – Alq_3 in the development of a versatile and disposable blue-light dosimeter for managing the radiation doses planning before treatment of jaundice of neonates. The results show that the color and photoluminescence of the sensor shifts from orange-red to green with the radiation exposure time. This effect is attributed to the photo-oxidation process of MEH-PPV. These changes were used to design a smart sensor working as an indicative sensor in order to represent the radiation exposure time used in management of neonatal jaundice during phototherapy.

Blue-light phototherapy is the most widespread treatment of neonatal jaundice [1] since it is devoid of all complications of an invasive procedure and presents the same spectral emission as the electronic absorption spectrum of bilirubin [2]. It acts in the sense to further reduce the bilirubin level [3] of an infant's serum concentration and, thus, to prevent serious complications, such as handicap, kernicterus, or death [3]. Although most jaundice in newborn infants is not serious and it is easily and relatively inexpensive to be controlled with efficient phototherapy, two factors may alter the rate of decline in serum bilirubin level of neonates: (*i*) the spectrum and (*ii*) the total dose of light delivery [4], in such a way that incorrect spectrum of the lamps used, inadequate body surface area, and light source to far from the infants are problems commonly related to the optical efficacy of this treatment. As a consequence, the need for an effective management of the radiation doses planning before treatment of jaundice is therefore obvious. In order to design a novel device for this purpose, the luminescent and organic materials, such as the aluminum-tris(8-hydroxyquinoline) - Alq3 and the poly[2-methoxy-5-(2'-ethyl-hexyloxy)-1,4-phenylene vinylene - MEH-PPV, commonly employed in green and orange-red light-emitting diode [5], respectively, appear here as active materials for smart sensors of blue-light radiation, since there is an overlap between photoluminescence spectrum of Alq_3 and absorption spectrum of MEH-PPV, Figure 1. When the system is exposed to blue-light irradiation, Figure 2, changes on the color and photoluminesce of the material is also observed. This change is attributed to the photoxidation process of MEH-PPV [6], and results in a shift from orange-red (λ_{max} = 600 nm) to green (λ_{max} = 543 nm) with the radiation exposure time. This results is used to development smart sensors for an effective management of the radiation doses planning before treatment of neonatal in which the needs of the control of dose absorption of infants is extremely important, Figure 3. Advantages of the use of this smart sensor are low cost (US$0.10), easy to make, easy to read, easy to operate, and accuracy for individual monitoring.

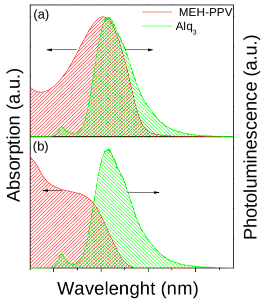

Figure 1: PL spectra of Alq_3 and ABS spectra of MEH-PPV (a) before and (b) after blue-light exposure.

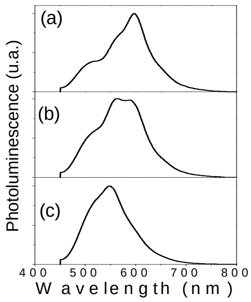

Figure 2: PL spectra of MEH-PPV/Alq_3 in polystyrene matrix exposed at blue-light during (a) 0min; (b) 240min and (c) 480 min.

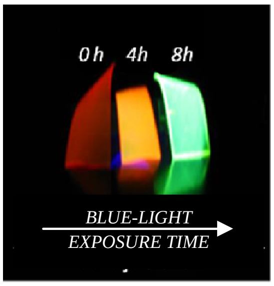

Figure 3: MEH-PPV/Alq_3 in polystyrene matrix exposed at blue-light during 0min, 240min and 480 min.

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