

A new hybrid organic-inorganic sunscreen filter with Uvinul A Plus[®] and ZnO nanoparticles

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Abstract – In this work a new hybrid organic-inorganic association between Uvinul A Plus[®] and ZnO nanoparticles was studied. Two preparation routes were used to achieve the associations, leading to final products with different spectroscopic properties. The hybrid filter prepared by the sol-gel method, in which, ZnO is precipitated in the presence of the organic filter, exhibits an extended UV absorption range, and it seems suitable for the application as a potential sunscreen filter.

In the last years the concern about the increase of UV radiations at the earth's surface give rise to the development of high efficiency sunscreens in order to minimize sun damage in the skin. A new and potential sunscreen filter is the association of organic and inorganic filters leading to a hybrid filter, which may improve protection efficiency and chemical stability [1]. Thus, the aim of the present work is to describe the preparation of a hybrid sunscreen filter using the commercial organic filter 2-(4-diethylamino-2-hydroxybenzoyl)-benzoic acid hexylester, the Uvinul A Plus[®] (uap) with zinc oxide (ZnO) from different methods and characterize its structural and optical properties. The ZnO/uap was prepared by two methods. In the first method, ZnO, with a 30 nm mean particle diameter, was fired at 900°C for 3 h and then suspended in a mixture of water/ethanol using an ultrasonic bath for 30 min. The pH of the suspension was adjusted at 8 with ammonium hydroxide (NH₄OH), a value lower than the ZnO isoelectric point and basic enough to ensure deprotonation of the uap phenol group. A solution of uap in water/ethanol mixture was added to the ZnO suspension with 1:1 ZnO/uap molar ratio. The resulting mixture was left under reflux at 50°C for 3h and the final product was named as sample A. In the second method, ZnO was prepared by the sol-gel method in the presence of the organic filter uap. A solution of zinc acetate mixed to uap in anhydrous ethanol with a 1:1 Zn/uap molar ratio was left under reflux at 50°C for 3 h. At the end of the reflux, a mixture of water/ethanol was added to the product and the systems maintained in an ultrasonic bath for 2.5 h to complete the hydrolysis process. The hydrolytic product was then named sample B. The samples were characterized by FT-IR and diffuse reflectance spectroscopy. Both methods are efficient to prepare ZnO/uap hybrid filters, but samples A and B present different spectroscopic properties. The FT-IR spectra (Figure 1) show the Zn-O stretching band centered at approximately 500 cm⁻¹. Besides that, typical uap bands figure in the spectrum, however the bands associated with the carbonyl group centered at 1700 cm⁻¹ are shifted; a characteristic that indicates the chemical interaction between the surface of ZnO and the carbonyl group of uap. Figure 2 presents the diffuse reflectance spectra of samples A and B, along with the spectrum of uap. Samples A and B have absorption edges at 400 and 450 nm respectively. Sample A have a blue shift of the absorption edge, which is ascribed to the decrease of the mean particle size in relation to sample B. Furthermore, it indicates that nano-hybrid organic-inorganic associations prepared by the sol-gel method are suitable for applications in sunscreens.

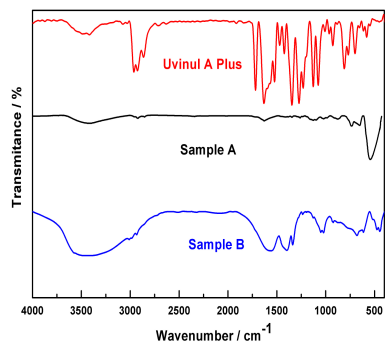


Figure 1: FT-IR spectra of Uvinul A Plus[®] and the hybrid filters (samples A and B).

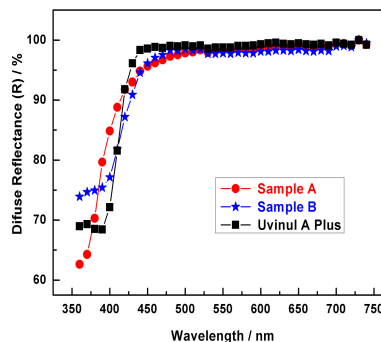


Figure 2: Diffuse reflectance spectra of Uvinul A Plus[®] and the hybrid filters (samples A and B).

References

[1] J. Flor, et al. Química Nova 30 (2007) 153-158.