PHOTOCHEMICAL ELABORATION OF HYBRID MATERIALS BASED ON POLY(3,4-ETHYLENEDIOXYTHIOPHENE) AND TIO_2

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Hybrid material results from the combination of two types of compounds. An interesting property can be obtained because of the possible interactions between the different materials involving in the composite. Anticipated applications of the hybrid materials range from bio- and gas-sensors, fuel cells, organic solar cells, photovoltaic devices to rechargeable solid state batteries. There are several ways to obtain hybrid materials : blending, interpenetrating network, chemical or electrochemical deposition. The process used to synthesize it depends upon the application field, and the properties of the compounds involving in the composite. In this work, we elaborate a hybrid material based on a *p*-type organic semiconductor, poly(3,4-ethylenedioxythiophene) (PEDOT), and a *n*-type inorganic semiconductor, TiO_2, by using a photochemical approach. This method allows us to obtain a heterojunction *p-n* between organic and inorganic materials. PEDOT is one of the most stable organic conducting polymer in its neutral and p-doped state. As in the case of the other conducting polymer, PEDOT can be prepared chemically via oxidative polymerization.

The photoelectrochemical properties of TiO_2 is well known. In aqueous solution, TiO_2 can generate a several radical species during the photochemical reactions. The process is initiated by the band-gap excitation of the TiO_2 under UV illumination. The electrons and holes thus produced diffuse to the surface and react with surface species. A polymerisation of PEDOT on the TiO_2 surface has been revealed and exalted by addition of H_2O_2. The presence of PEDOT on the TiO_2 surface is shown by the color change of the TiO_2 surface (dark blue). In this present work, we report the results of the study on the characterization of the TiO_2/polymer hybrid materials using Fluorescence U.V. , Fourier transformed infrared spectroscopy, XRD and thermal analysis.

In order to follow the hydroxyl radical OH production during TiO_2 photocatalysis, We use the fluorescence method using terephthalic acid as a probe. As shown in Figure 1, a decrease of the available hydroxyl radical is observed in the presence of EDOT monomer in solution. This behavior is due to the surface reaction between EDOT monomer and the highly reactive species, especially hydroxyl radical, generated by TiO_2 photocatalysis. FTIR measurements confirm the presence of PEDOT on the TiO_2 surface.

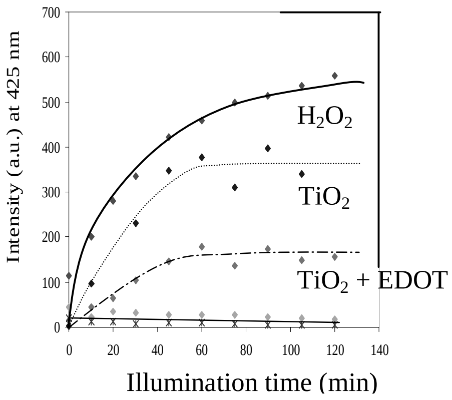

Fig. 1. Variation of the fluorescence spectra during illumination of TiO_2 in terephthalic acid solution ($4\ 10^{-4}$ M, excitation at 315 nm).