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FABRICATION OF ELECTROSPUN TIO2 NANOFIBERS FROM POLY(BUTYLENES ADIPATE-CO-TEREPHTHALATE) / P25 NANOCOMPOSITE. APPLICATION IN PHOTOCATALYSIS

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Abstract: Titanium dioxide (TiO_2) is one of the more used semiconductors available for photocatalysis, due to its high photoactivity, low cost, chemical and biological inertness and durability. In photocatalytic reactions a high surface-to-volume ratio (S/V) is extremely important. Nanoparticles (NPs) satisfy that criterion, but in normal applications TiO_2 NPs have a strong tendency to agglomerate into larger particles. TiO_2-based fibers with large aspect ratio can overcome the agglomeration problem keeping high S/V ratio. In the present contribution TiO_2 nanofibers were prepared using the electrospinning technique. In a first step nanocomposites fibers were produced by dispersions of TiO_2 NPs (AEROXIDE®TiO2-P25) on a synthetic biodegradable aliphatic-aromatic copolyesterpoly(butylenesadipate-co-terephthalate) (PBAT) using 2,2,2 Triflourethanol as solvent. The TiO_2 concentration was varied as: 0.04%, 2.5%, 5%, 10% and 12.5% w/w. In a typical electrospinning procedure, the precursor solution was loaded into a syringe equipped with a stainless steel needle. An electric voltage of 16.5 kV was applied between the needle and the target. The distance between the needle and the target was 15 cm and a stable flow rate of 1 mL/h was maintained during the process. After the electrospinning step the fibers were thermal threaded (TT) at 450ºC in air atmosphere to eliminate de organic contents of the composite and keep the more active photocatalytic anatase phase intact. The fibers were analyzed before and after TT by water contact angle, optical profilometry, SEM, EDS, FTIR-ATR and DRX. The results showed the formation of nanocomposite fibers of 250-1000 nm in diameter. After TT the TiO_2 nanofiber dispersion was maintained. Some degree of agglomeration was observed when a high TiO_2 concentration was used. Ti elemental concentration measured by EDS matched the initial concentration used for the nanofiber preparation. For example, when the TiO_2 concentration used in the initial mixture was 0.04%, 2.5%, 5% and 10% w/w, the elemental composition of Ti measured by EDS was 0.03%, 2.5%, 5.2% and 11.3% respectively. FTIR-ATR results also showed an increase in the signal corresponding to the broad band at 700 cm^{-1} corresponding to Ti–O–Ti stretching of TiO_2 when the TiO_2 concentration used in the initial dispersion increased. EDS and FTIR-ATR results confirmed the efficient incorporation of TiO_2 in the prepared nanocomposites fibers. Functionalization of the TiO_2 NPs with Trimethylpropyl silane before the electrospinning process to avoid the formation of bids and photocatalytic tests using methyl orange as pollutant prototype are under way.

Keywords: Electrospinning, titanium dioxide, nanocomposites fibers, photocatalysis, pollutant degradation.