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IMPARTING PHOTOCATALYTIC AND ANTIOXIDANT PROPERTIES TO ELECTROSPUN POLY (L-LACTIDE-CO-D,L-LACTIDE) MATERIALS

Ina Anastasova, Petya Tsekova, Milena Ignatova, Olya Stoilova
Bulgarian Academy of Sciences, Institute of Polymers, Laboratory of Bioactive Polymers, 1113 Akad. G. Bonchev St., bl. 103A, Sofia, Bulgaria
i_anastasova@polymer.bas.bg

Introduction Electrospinning is a simple and low-cost technique for fabrication of polymer fibers with multiple applications. Poly(L-lactide-co-D,L-lactide) (PLDLLA) is biodegradable and biocompatible, amorphous copolymer, which degrades faster than the homopolymer. Zinc oxide (ZnO) is biocompatible, has low toxicity and good antimicrobial activity against a number of pathogens. Moreover, ZnO shows excellent UV-absorption and photocatalytic activity. Despite these promising properties, freely suspended ZnO particles are difficult to separate from the reaction medium, leading to secondary pollution. Thus, in this study we have chosen to avoid the difficulty in the removal of the particles and to combine the properties of PLDLLA and ZnO, in order to prepare hybrid fibrous materials with purposely tailored design for photocatalytic water purification.

Experimental part PLDLLA was kindly donated by Boerhinger-Ingelheim. Commercially available ZnO (Zano®20, Umicore Zinc Chemicals) was used as received. The quaternized N,N,N-trimethyl chitosan iodide (QCOS) was synthesized from chitosan oligomer (COS, 10000 g/mol, Kitto Life Co. LTD, Korea).

Results Simultaneous electrospinning of PLDLLA (5% w/v) solution and electrospraying of an aqueous ZnO dispersion (1 wt%) resulted in fabrication of materials with design type “on”. The electrospraying was conducted at a 5 cm tip-to-collector distance and 1 mL/h flow rate [1]. In the electrosprayed dispersion, the QCOS serve as excellent stabilizing agent for ZnO and as sticking agent for the fixation of ZnO particles onto PLDLLA fibers.

Discussion The morphology of the electrospun materials was observed by SEM, equipped with EDX and TEM. TGA and XRD analyses show that the presence of inorganic particles had an impact on the thermal properties and crystallinity of the fibrous PLDLLA materials. It was shown that the presence of ZnO onto the surface of the PLDLLA fibers considerably increased their antioxidant activity, determined by the DPPH free radical assay, and their photocatalytic activity, determined by the degradation of the model organic pollutant methylene blue (MB) dye under UV-light irradiation.

Conclusions Purposely tailored design type “on” provided improved antioxidant activity and excellent photocatalytic degradation of model organic pollutant MB under UV light irradiation even after 5-fold use. Therefore, the prepared electrospun hybrid materials based on PLDLLA are promising for water purification from organic pollutants and dyes by heterogeneous photocatalysis.

Keywords: *electrospinning, electrospraying, PLDLLA, ZnO, antioxidant activity, photocatalytic activity*

[1] Anastasova, I.; Tsekova, P.; Ignatova, M.; Stoilova, O. Imparting Photocatalytic and Antioxidant Properties to Electrospun Poly(L-lactide-co-D,L-lactide) Materials. Polymers 2024, 16, 1814.

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