Photocatalyctic Nanofiber Production and Applications

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The objective of this study was to develop TiO_2-doped membranes; hence the resulting membranes would be cost-effective and sustainable for the applications such as water purification. The hypothesis was that TiO_2-doped membranes enhance stability and photocatalytic activity to be a wide range of uses. Because Polyacrylonitrile (PAN) is a thermoplastic polymer, it is ideal for being skeleton nanofibers in the membranes. Polyamide-6 (PA6) and TiO_2 respectively provide mechanical stability and water permeability.

During the study, electrospinning and electrospraying techniques were used. Prior to electrospinning and electrospraying, PAN, PA6 and TiO_2 solution was respectively prepared in the concentration of 10, 13 and 10 wt%. The processes were carried out for 1 h each at ~25 °C with relative humidity under 50%. For PAN, PA6 and TiO_2 solutions, positive voltages of 15 kV, 20 kV and 15 kV were respectively applied, the feed rates were set at 0.7, 1 and 0.7 mL/h by using 10 mL-syringe pumps, and distance between syringe pumps and the roller was 18, 15 and 15 cm, and the rotating speed was set at 100 rpm. The electro spun nanofibers were collected as almost randomly overlaid membrane on the surface of PET, firstly in ordinary way as 1-layer (PAN or PA6 only), 3-layer (PAN-PA6-PAN respectively) and 5-layer (PAN-PA6-PAN-PA6-PAN respectively) and lastly in TiO_2 doped way as 3-layer covered (PAN-PA6-TiO_2-PAN respectively) and 3-layer uncovered (PAN-PA6-PAN-TiO_2 respectively). After the electrospinning and electrospraying processes, membranes incubated in 1 h at ~50 °C as post-treatment.

All the samples were examined in SEM, FTIR, SEM-EDX. In as-collected layer by layer membranes, both PAN and PA6 electrospun nanofibers were morphologically uniform with cylindrical shape; and the two types of nanofibers had no appreciable discrepancies. Owing to the preparation method of simultaneous electrospinning and collection, the two types of nanofibers are expected to be randomly distributed in the membranes. TiO_2 nanoparticles were placed as spherics on the bounds.

In the experiments, the equilibration time is found as 8 h for each membrane, then the Langmuir Isotherm is calculated for different weight of membranes. They were exposed to UV light irradiation for 8 hours. TiO_2-doped-covered membranes could absorb 60% of MB under UV light irradiation; while TiO_2-doped-uncovered membranes could absorb 50% of MB

under UV light irradiation in the equilibration time.

This study suggested that, TiO_2-doped membranes increase the surface area and enhance dye removal. These membranes could be innovative, sustainable and economically feasible with high performance for various applications (e.g., water purification).

***Keywords*:** Electrospinning, Electrospraying, Water purification, Sustainability