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Fouling-resistant brush-like oligomers of poly(3-aminophenol)

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ABSTRACT

Membrane fouling can be considered the major obstacle in the application of membranes in different separation processes. This drawback can be minimized (or avoided) by cutting off the interaction between the foulant itself and the membrane's surface. For that, membrane surface modification has been presented as an effective tool to improve the membrane's performance. In the current paper, laccase-catalyzed bio-grafting of 3-aminophenol (3-AP) onto poly(ethersulfone) (PES) membranes is presented. This modification was carried out at room temperature and in aqueous medium using green catalyst; thus, the process can be safely labelled "green surface modification". The modified PES membranes were evaluated based on their performance and bulk properties. The effects of modifications on the membranes' performance, the flux reduction, and the protein repellence were assessed. Also, the flux reduction due to (irreversible) protein adsorption was determined. The change in the color of the modified membranes was also correlated to the amount of the added modifier per unit membrane area (the grafting yield). Both blank and modified membranes were characterized using TGA, DSC, XRD, FTIR-ATR, ^{1}H-NMR, SEM as well as mechanical strength testing. Moreover, the shape and structure of the modified layer(s) grafted on the spin-coated PES layer on silicon dioxide slides were investigated using other analytical techniques that include the static water contact angle, scanning probe microscope (SPM), and Raman spectroscopy. This green modification slightly improved both the membranes' performance and the membranes' bulk properties. The water flux of the modified membranes increased up to 35% relative to the blank (unmodified) membrane, and the protein adsorption was reduced up to 90%. In addition, a very slight change in the membranes' strength was observed. The formed layer(s) most likely contain both free amine groups and hydroxyl groups that are present as brush-like oligomers of 3-AP grafted on the membrane surface.

Keywords: Poly(ethersulfone) membrane; Antifouling surface; 3-aminophenol; Biocatalysis; Brush-like oligomers; Green surface modification

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