Novel organic solvent nanofiltration membrane based on inkjet printing-assisted layer-by-layer assembly

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Abstract

Novel layer-by-layer (LBL) organic solvent nanofiltration (OSN) membrane was developed via inkjet printing of polyethyleneimine (PEI) and single walled carbon nanotube (SWCNT) on a polyketone (PK) membrane surface, followed by post-treatment using three different cross-linking agents: glutaraldehyde (GA), (±)-epichlorohydrin (ECH) and trimesoyl chloride (TMC). The effects of PEI and SWCNT concentrations, bilayer numbers, and cross-linking conditions in the formation of the selective layers were evaluated in terms of membrane OSN performances. PEI concentration of 10.0 g/L and SWCNT concentration of 1.0 g/L with eight cycles of printing bilayers were chosen as optimal conditions. GA cross-linking was found to give the best membrane performance, and thus GA was considered as the best cross-linking agent for inkjet-printed LBL membrane modification among the three kinds of cross-linkers. The $(PEI/SWCNT)_8$-GA exhibited Rose Bengal (RB) rejection over 99% with high organic solvent permeances. Compared to the cross-linking time, cross-linking agent concentration was found to have a greater effect on the membrane modification in terms of rejection performance. Moreover, the inkjet-printed LBL membrane showed negligible changes in membrane weight and OSN performance after immersion in different organic solvents over a period of three weeks, indicating its high mechanical and chemical stability. Finally, the possible applications of our printed LBL membranes in the pharmaceutical and hemp industries were evaluated. Overall, our work could further develop inkjet printing method for LBL OSN membrane fabrications.

Keywords

Inkjet printing; Layer-by-layer assembly; Polyethyleneimine; Single-walled carbon nanotube; Organic solvent nanofiltration