A facile fluorination of UF membranes by direct coating of perfluoropolymers to enhance antifouling properties for water purification

Thien Tran [a], Yi-Chen Tu [a], Stephanie Hall-Laureano [b], Chen Lin [a], and Haiqing Lin [a,*]

[a] Department of Chemical and Biological Engineering, University at Buffalo, The State University of New York, Buffalo, NY 14260, USA.

[b] University of Puerto Rico – Mayaguez, Mayaguez, 00682, Puerto Rico

[*] Corresponding author. Tel: +1-716-645-1856, Email: haiqingl@buffalo.edu (H. Lin)

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Abstract

Polymeric membranes for water purification are often fouled by the contaminants (e.g. suspended solid, dissolved organic matters, etc.), drastically reducing water permeance. To overcome this challenge, a variety of approaches to modify membrane surface have been explored to enhance antifouling properties. However, most of these approaches may be involved with complex chemical reactions and thus they are not easily integrated into the industrial membrane production lines. In this work, we demonstrate a facile fluorination of UF/MF membranes by direct coating of "non-sticking" Teflon AF1600, an amorphous glassy perfluoropolymer with excellent film forming ability and antifouling properties to organic matters. Specifically, commercial membranes with different molecular weight cut-off (MWCO) were coated with solutions containing various content of Teflon AF1600 (0.02 to 0.05 wt.%). Interestingly, the fluoropolymer coating lies on the solid portion of the membranes without covering the pores, as evidenced by the SEM. As the Teflon AF1600 concentration increased from 0 to 0.05%, the coating layer thickness increased from 0 to 7.0 nm, the membrane surface became smoother, and the water contact angle increased from 63° to 102°. When the Teflon AF1600 concentration increased from 0 to 0.035% for an example PES UF membrane, the MWCO decreased from 10,000 Da to around 2,500 Da, and the water permeance decreased from 97 liter/m^2·hr·bar (LMH/bar) to 34 LMH/bar. The antifouling properties was evaluated using water containing 3 g/L bovine serum albumin (BSA) as a model foulant. To obtain the same amount of permeated water, the modified UF membranes exhibited lower water flux decline (35% reduction) than unmodified one (50% reduction). To further confirm the antifouling properties, the BSA adsorption on the membrane surface was determined. The coating with 0.02 % Teflon AF1600 decreases the BSA adsorption from 14 μg/cm^2 to 6 μg/cm^2.