Modeling the antifouling properties of atomic layer deposition surface-modified ceramic nanofiltration membranes

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Abstract

This work investigates the enhancement of antifouling properties of ceramic nanofiltration membranes by surface modification via atomic layer deposition (ALD) of TiO_2. Feed solutions containing bovine serum albumin (BSA), humic acid (HA) and sodium alginate (SA) were used as model foulants. The classic fouling mechanism models and the modified fouling indices (MFI) were deduced from the flux decline profiles. Surface roughness values of the ALD coated and uncoated membranes were 63 and 71 nm, respectively, while the contact angles were 34.2 and 59.5°, respectively. Thus, coating increased the water affinity of the membrane surfaces and consequently improved the anti-fouling properties. The MFI values and the classic fouling mechanism correlation coefficients for cake filtration for the ALD coated and the uncoated membrane upon SA fouling were 42 963 (R^2 = 0.82) and 143 365 sL^{-2} (R^2 = 0.98), respectively, whereas the correlation coefficients for the combined foulants (SA+BSA+HA) were 267 185 (R^2 = 0.99) and 9 569 sL^{-2} (R^2 = 0.37), respectively. The study showed that ALD can effectively enhance the antifouling properties of ceramic membranes.

Keywords: Atomic layer deposition; ceramic membranes; fluorescence spectroscopy; modified fouling index; molecular weight cut off