Zwitterionic Polydopamine as an Antifouling Agent in Ultrafiltration System

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Abstract:

In this work, a novel zwitterionic PDA-based nanohybrid (ZrSiPD) was successfully synthesized via simultaneously alkaline hydrolysis of zwitterionic silica precursor (ZrSiP) and oxidative polymerization of dopamine monomers followed by condensation reaction. The obtained ZrSiPD nanohybrid was applied as a nanofiller to improve the water permeability and antifouling property of PES ultrafiltration process. The successful synthesis of ZrSiPD nanohybrid and the modified ultrafiltration was supported through ATR-FTIR, TGA, SEM-EDX, ζ potential, and contact angle measurements. The ZrSiPD nanohybrid was utilized to fabricate membranes at different loading percentages up to 8 wt.% via NIPS method. The improvement in the modified membrane's surface properties (hydrophilicity, surface charge, and pore structures) have remarkably enhanced their antifouling properties against HA foulant. The water flux of the ZrM8 hybrid membrane was reported to be around 473 L $m^{-2}h^{-1}$, which is around 8% higher than the pure water flux achieved by pristine membrane. The antifouling activity was evaluated using HA solution of 50 ppm, and the modified membranes have experienced an enhanced rejection rate of up to 91%. ZrM4 membrane was shown to be the least susceptible membrane to HA fouling, and almost 98% FRR value certifies an outstanding elimination of poorly adhered HA layer from the surface of ZrM4. R_{ir} values of all hybrid membranes were lower than pristine membrane, with the minimal R_{ir} value observed in ZrM4 with 1.64%.

Keywords: Ultrafiltration; Zwitterionic polydopamine; nanohybrid; antifouling; HA separation

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