Antifouling Modification of Ultrafiltration Membranes by Grafting Polyzwitterionic Brushes

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Fouling control is critical in membrane-based water treatment processes due to its detrimental effects on system performance and overall energy efficiency. In this work, we develop an antifouling modification for ultrafiltration (UF) membranes by grafting polyzwitterionic brushes via surface-initiated atom transfer radical polymerization (ATRP). Bio-inspired polydopamine (PDA) was first used to immobilize 2-bromoisobutyryl bromide (BiBB) on the membrane surface, which initiated polymerization of zwitterionic sulfobetaine methacrylate (SBMA). Various characterization techniques, including electron microscopy, contact angle measurement, and FTIR spectra proved the successful modification of the membranes with zwitterionic polymer brushes.

Dead-end filtration experiments for the modified membranes showed the effects of various modification conditions, including duration of PDA deposition and thickness of the polymer brush, on water permeability and molecular weight cutoff characteristics. An optimal duration of PDA deposition was found at which a dense polymer brush was obtained with minimal impact on the water permeability. Antifouling properties were assessed by a bovine serum albumin (BSA) adsorption test. The modified membrane exhibited a significantly lower adsorption of BSA than the pristine membrane, indicating a high fouling resistance against proteins. This simple antifouling modification technique has the potential to significantly mitigate membrane fouling, without compromising transport properties.