Influence of chemical coating combined with nanopatterning on alginate fouling during nanofiltration

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Treatment of impaired waters for beneficial use exposes membranes to feed waters containing biological and abiotic species, which leads to fouling and loss of membrane productivity over time. Since reduction in flux due to fouling is one of the largest costs associated with membrane processes in water treatment, new membrane modification methods that limit fouling would have significant economic and societal impacts**.** The focus of our work is to develop such a method.

Prior studies in this area largely have focused on chemical modifications to the membrane surface to limit fouling. Based on considerable literature and experience, we know that chemical modification strategies alone can be effective but not sufficient for controlling fouling. The discovery that sub-micron patterning of a membrane surface can improve its fouling resistance provides an orthogonal membrane design parameter. Our hypothesis is that combining chemical modification and patterning will yield membrane surfaces that are more effective at fouling control than either method alone. This strategy is unique in its use of both chemical coating and patterning to combat fouling.

This contribution describes our method to increase the fouling resistance of nanofiltration membranes by applying both a chemical coating and a nanoscale pattern to the membrane surfaces. A line and groove nano-pattern was applied by thermal embossing directly onto a commercial polyamide thin-film composite nanofiltration membrane. Poly(ethylene glycol) diglycidyl ether (PEGDE) was reacted onto the patterned membrane surfaces by an epoxide ring opening reaction with unreacted carboxyl groups on the polyamide selective layer. Membrane performance was evaluated by measuring flux and salt rejection using a magnesium sulfate solution and by measuring flux reduction using an alginate solution. Surface characterization showed successful patterning and chemical modification of the membrane surface. Flux and salt rejection properties were unaffected by patterning the polyamide membrane surface directly. The filtration results with alginate solutions show that combining line and groove nano-patterning with PEGDE chemical modification yields a membrane that is more resistant to fouling than either method alone.