pH-responsive membranes for treatment of wastewaters

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Abstract. Increasing environmental awareness and raw material prices have lead to increased exploration of nonconventional alternative energy sources. Specifically, coal bed methane and oil shale have been pursued as a means of fuel oil production; however, these sources of energy often lead to the production of large amounts of co-produced water which contains dissolved solids and oils. This waste water could serve as a potential solution to increasing water demands in industrialized nations, particularly arid regions such as the western United States, but the composition of these produced waters makes traditional treatment methods difficult and expensive. Membrane filtration has been proposed but thus far has been unsuccessful because of rapid membrane fouling.

Commercially available nanofiltration membranes have shown promise for converting these waste waters into water for beneficial uses if fouling could be minimized. To that end nanofiltration membranes have been modified so that their properties are responsive to feed pH. Acrylic acid nanobrushes were grown on the surface of the membranes via UV-initiated polymerization. These nanobrushes will swell or contract based on the pH of the feed stream. This occurs when the feed pH is below or above the isoelectric point of acrylic acid, respectively. The state of the nanobrushes will affect the filtration properties of the membrane leading to improved performance. With continued study, this technology could result in clean water—suitable for uses such as irrigation or livestock watering—from a previously discarded waste stream.