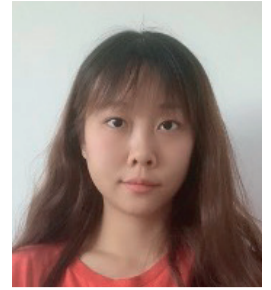


Stable Polyelectrolyte multilayer based membranes for produced water treatment under harsh conditions



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Motivation

Enhanced Oil Recovery in the petroleum industry typically involves injecting three or more barrels of water into the reservoir to produce one barrel of oil. The large volume of water that ends up in the production well is so called produced water (PW)^[1]. Due to the complex composition of PW, its processing for discharge is challenging and costly^[2]. Treating PW for re-use offers a more sustainable option. Polyelectrolyte multilayer (PEM) based membranes prepared by layer-by-layer (LbL) assembly have recently shown to be promising for treating PW for re-use (Fig 1)^[3]. However, PW can have very harsh conditions, including high salinity, extreme pH values, the presence of dissolved organics and problematic chemicals. Therefore, it is crucial to further develop these PEM based membranes towards high stability under such conditions.

Technological challenge

Harsh conditions as high salinity can damage the PEM coatings. Some dissolved organics may also reduce the mechanical stability of the membrane support. The conversion of ionic bonds to covalent bonds by chemical crosslinking can improve the stability^[4]. However, this process may also affect the separation performance of the obtained membranes. We propose to develop a unique PEM-based membrane with both high stability and excellent performance in selectivity, permeability, and fouling resistance (Fig 2).

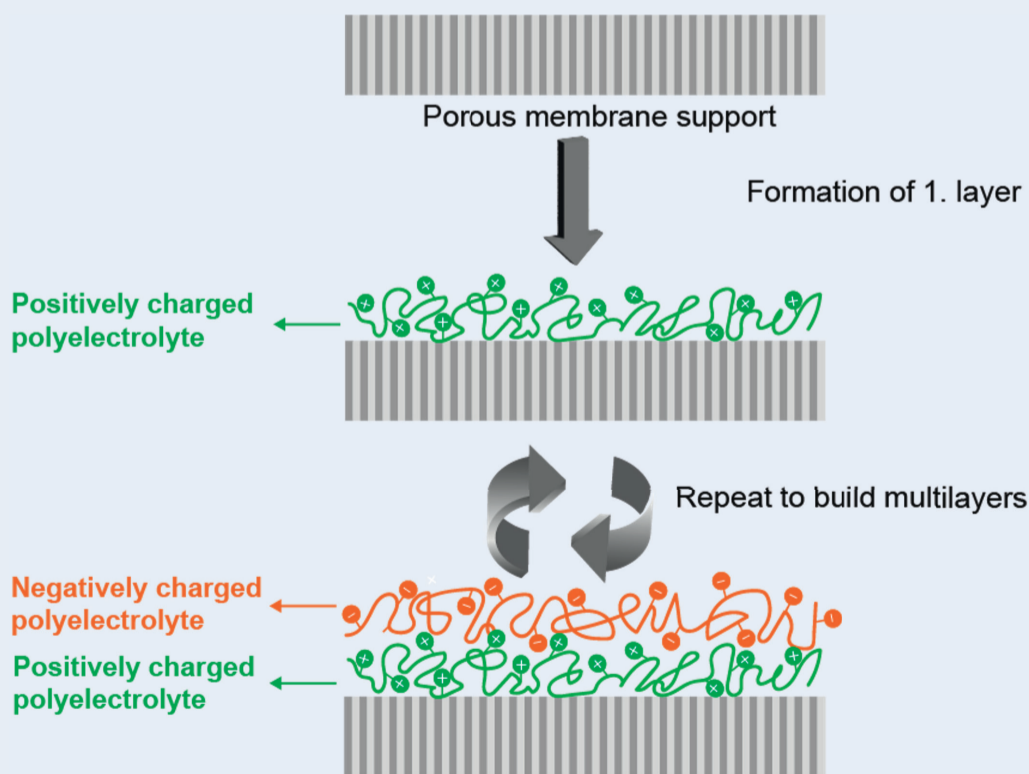


Fig 1. Schematic illustration of a PEM based membrane prepared by layer-by-layer deposition of oppositely charged polyelectrolytes on ultrafiltration membrane support.

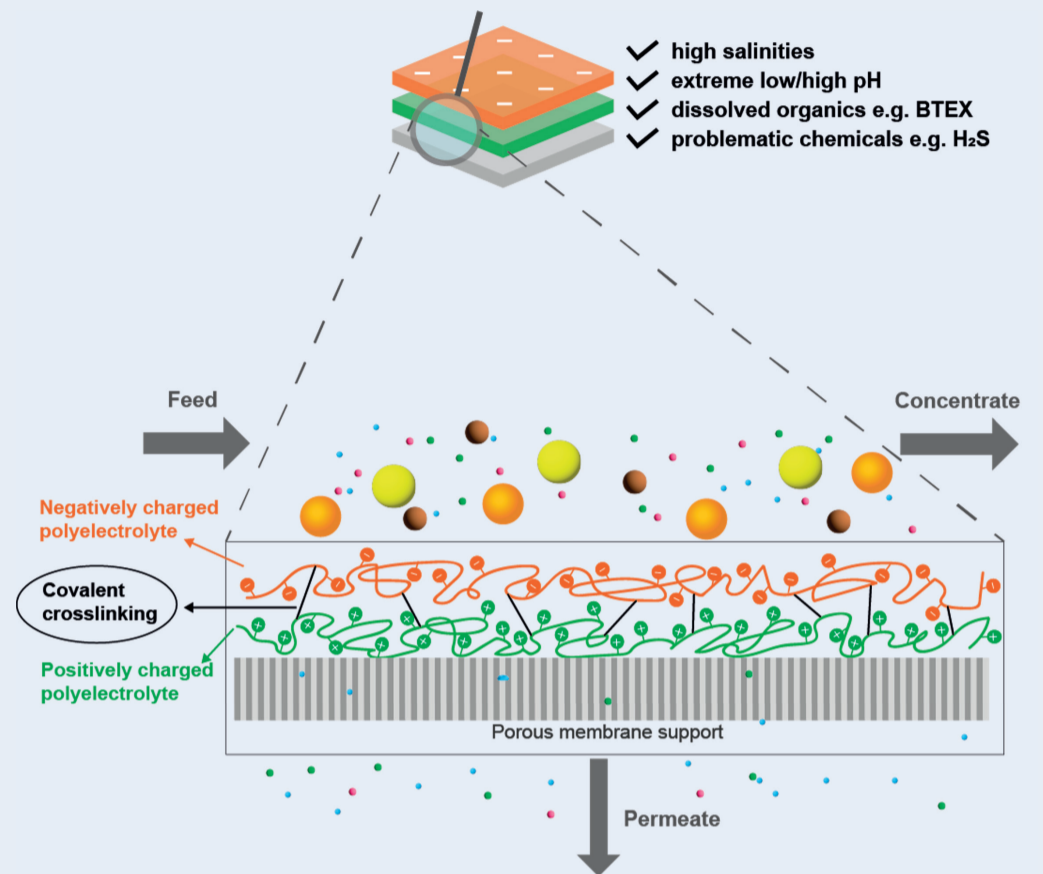


Fig 2. Schematic depiction of produced water treatment with crosslinked stable PEM based membranes. The PEM membranes remain stable under the harsh conditions and allow effective removal of oil droplets, multivalent salt and some dissolved organics.

Research goals

- To study the stability of PEM coatings and their supports under harsh conditions, and to demonstrate the range of harsh conditions under which PEM based membranes can be successfully applied in produced water treatment.
- To develop a crosslinked PEM coating that would allow stability even under harsh conditions.
- To investigate fouling under the described harsh conditions.
- To translate the obtained insights into relevant process designs for the treatment of specific produced water streams for re-use.

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