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A facile avenue to modify polyelectrolyte multilayers on anion exchange membranes to enhance monovalent selectivity and durability simultaneously

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Abstract:

Layer-by-layer deposition of polycations and polyanions multilayers on the surface of anion exchange membranes (AEMs) is a simple and versatile method to obtain monovalent anion selectivity. However, the stability of the polyelectrolyte multilayers (PEMs) can be compromised by the weak interactions formed between the deposited barrier and the pristine membrane surface. In this sense, cross-linking appears as an efficient method to improve the chemical stability of PEMs by covalent bonding. In this investigation, polyelectrolyte multilayers was coated on commercial AEMs by alternating electro-deposition with polystyrene sulfonate (PSS) and 2-hydroxypropyltrimethyl ammonium chloride chitosan (HACC). Subsequently, photosensitive molecules (4,4-diazostilbene-2,2-disulfonic acid disodium salt (DAS)) were mixed into the loose multilayers by soaking in the DAS solution and chemical bonds were formed in the membrane by UV irradiation. The chemical composition and structure of the membrane were confirmed and observed by infrared spectroscopy, atomic force microscopy and scanning electron microscopy. The monovalent selectivity and durability were evaluated by electrodialysis (ED) in a $\text{Cl}^-/\text{SO}_4^{2-}$ system. The optimized membrane was found to have a stable selectivity during the entire duration of testing (80 hours), and while a conventional multilayer modified AEMs completely loses its selectivity after 30 hours. Furthermore, the modification process improved the monovalent anion

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