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Advanced Acid-base Blend Ion Exchange Membranes with High Performance for Vanadium Flow Battery Application

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Abstract: A high-performance acid-base blend ion exchange membrane is designed and prepared for vanadium flow battery (VFB) application. Through transferring H^+-SPEEK to Na^+-SPEEK, the compatibility of hydrophilic sulfonated poly(ether ether ketone) (SPEEK) and polybenzimidazole (PBI) is improved. A great balance between ion selectivity and proton conductivity for these blend ion exchange membranes based on SPEEK and PBI is realized, due to the internal cross-linked networks induced by the acid-base interaction. A very impressive VFB performance with a coulombic efficiency of 98.5% and an energy efficiency of 89.8% at a current density of 80 mA cm^{-2} is thus obtained, which are among the highest values ever reported for ion exchange membranes. Besides, these SPEEK-PBI blend membranes also possess excellent chemical, mechanical and thermal stability, showing very promising prospect for VFB application.

Keywords: vanadium flow battery; acid-base blend ion exchange membrane; sulfonated poly(ether ether ketone); polybenzimidazole; chemical stability