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Enhanced anhydrous proton conductivity of polymer electrolyte membrane enabled by facile ionic liquid-based hoping pathways

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Abstract:

Herein, a series of composite membranes based on sulfonated poly(ether ether ketone) (SPEEK) and imidazole-type ionic liquid (ImIL) are prepared through IL-swollen method as anhydrous electrolytes for fuel cell. The IL loading amount is accurately controlled by preparation conditions (e.g., ultrasonic power, treatment temperature, and treatment time). The influence of IL on physicochemical properties of composite membrane is systematically investigated. The IL is enriched into the ionic clusters of SPEEK matrix driven by electrostatic attractions, thereby broadening them to form inter-connected channels. IL provides anhydrous hoping sites and low-energy-barrier paths of imidazole-sulfonic acid pairs to composite membrane. Through the channels, these sites form facile pathways and significantly enhance the anhydrous conductivity of composite membrane. Particularly, the composite membrane containing 43% IL achieves a 52 times higher conductivity (9.3 mS cm^{-1}) than that of the control membrane (0.179 mS cm^{-1}) at 140 ^{o}C. Increasing IL loading amount will further elevate the anhydrous conductivity. The dynamic IL release and