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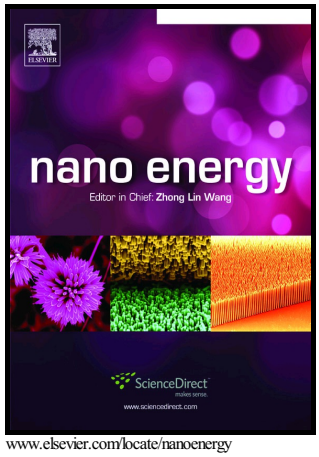

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Highly Selective Charged Porous Membranes with Improved Ion Conductivity

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Abstract

To enhance the power density of vanadium flow batteries (VFBs), an advanced charged porous ion conducting membrane with high selectivity and ion conductivity and high stability is designed via establishing consecutive ion transport channels on the pore walls. The consecutive ion transport channels are constructed by introducing partial pendant hydrophilic trimethylamine (TMA) groups on the pore walls of porous membranes with internal crosslinking networks, where more protons or hydroniums are able to be transferred along the channels via Grotthuss hopping-mechanism. As a result, a VFB single cell employing the optimized membrane exhibits a columbic efficiency (CE) of above 98% and a voltage efficiency (VE) of more than 90% at the current density of 80mA cm^{-2}. Even at a high current density of 160 mA cm^{-2}, a battery with a TMA-5 membrane still exhibits a CE of about 99% and an energy efficiency (EE) of more than 80%, and could continuously cycle more than 1500 charge-discharge cycles. This paper provides a possible solution to break the trade-off between selectivity and ion conductivity of porous membranes.