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Highly Selective Charged Porous Membranes with Improved Ion Conductivity

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**Highly Selective Charged Porous Membranes with Improved Ion Conductivity**Yuyue Zhao<sup>a,c</sup>, Huamin Zhang<sup>a,b</sup>, Chuanhai Xiao<sup>d</sup>, Lin Qiao<sup>a,c</sup>, Qiang Fu<sup>d</sup>, Xianfeng Li<sup>a,b</sup><sup>a</sup>Division of Energy Storage, Dalian Institute of Chemical Physics, Chinese Academy of Sciences, Zhongshan Road 457, Dalian 116023, China<sup>b</sup>Collaborative Innovation Centre of Chemistry for Energy Materials (iChEM), Dalian 116023 (P.R. China)<sup>c</sup>University of Chinese Academy of Sciences, Beijing 100039, China<sup>d</sup>State key Laboratory of Catalysis, Dalian Institute of Chemical Physics, Chinese Academy of Sciences, Dalian 116023, China

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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  $80\text{mA cm}^{-2}$ . Even at a high current density of  $160\text{ mA cm}^{-2}$ , 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.

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