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**Advanced Porous Membranes with Slit-like Selective Layer for Flow Battery**

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**Abstract**

An advanced porous membrane containing slit-like selective layer on its top surface is designed and prepared for flow battery application. The structure is realized by regulating the parameters during membrane formation process. The porous membrane exhibits a thick skin layer with narrow slits and sponge-like support layer in the cross-section. The thick and comparatively hydrophobic skin layer hinders the passage of vanadium ions. Meanwhile, the slit structure and comparatively hydrophilic support layer facilitates the transport of protons. The resulting poly(ether sulfone) (PES)/sulfonated poly(ether ether ketone) (SPEEK) porous membrane containing slit-like selective layer achieves an excellent balance between ion selectivity and proton conductivity, resulting in a columbic efficiency of 98.5%, a voltage efficiency of 91.7%, and an energy efficiency of 90.4% at 80 mA cm<sup>-2</sup>, which is much higher than a vanadium flow battery (VFB) with the commercial Nafion 115. Therefore, this paper

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