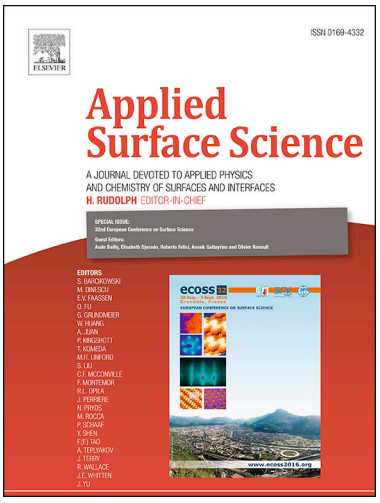
Accepted Manuscript




Full Length Article

# Novel branched sulfonated polyimide/molybdenum disulfide nanosheets composite membrane for vanadium redox flow battery application

Yang Pu, Shuang Zhu, Pohui Wang, Yuqin Zhou, Pan Yang, Sensen Xuan, Yaping Zhang, Hongping Zhang

PII: S0169-4332(18)31050-X
DOI: https://doi.org/10.1016/j.apsusc.2018.04.090
Reference: APSUSC 39089

To appear in: *Applied Surface Science*

Received Date: 26 October 2017
Revised Date: 25 February 2018
Accepted Date: 9 April 2018

Please cite this article as: Y. Pu, S. Zhu, P. Wang, Y. Zhou, P. Yang, S. Xuan, Y. Zhang, H. Zhang, Novel branched sulfonated polyimide/molybdenum disulfide nanosheets composite membrane for vanadium redox flow battery application, *Applied Surface Science* (2018), doi: https://doi.org/10.1016/j.apsusc.2018.04.090

# Novel branched sulfonated polyimide/molybdenum disulfide nanosheets composite membrane for vanadium redox flow battery application

Yang Pu, Shuang Zhu, Pohui Wang, Yuqin Zhou, Pan Yang, Sensen Xuan, Yaping Zhang*, Hongping Zhang

*Engineering Research Center of Biomass Materials, Ministry of Education, State Key Laboratory of Environmental Friendly Energy Materials, Southwest University of Science and Technology, Mianyang, Sichuan 621010, P. R. China*

**Abstract:** A novel branched sulfonated polyimide/molybdenum disulfide nanosheets (bSPI/$MoS_2$-ns) composite membrane was fabricated for vanadium redox flow battery (VRFB) application. Scanning probe microscope (SPM) and field emission-scanning electron microscope (FE-SEM) images verify the successful exfoliation of monolayer and a few layers of $MoS_2$ nanosheets. X-ray diffraction (XRD), attenuated total reflection-fourier transform infrared spectrometer (ATR-FTIR) and FE-SEM results demonstrate that bSPI, bSPI/$MoS_2$-ns and bSPI/$MoS_2$ nanopowders (bSPI/$MoS_2$-np) membranes are successfully prepared. Both thermogravimetric analysis/differential thermogravimetry (TGA/DTG) and ex-situ chemical stability testing results confirm bSPI/$MoS_2$-ns membrane has improved thermal and chemical stabilities in contrast with pristine bSPI membrane. The bSPI/$MoS_2$-ns membrane owns high proton conductivity ($5.04 \times 10^{-2}$ S $cm^{-1}$) and extremely low vanadium ion permeability ($0.65 \times 10^{-7}$ $cm^2$ $min^{-1}$), leading to its highest proton selectivity ($7.75 \times 10^5$ S min $cm^{-3}$) among all the membranes tested. Besides, during 500 times cycle charge-discharge test, the coulombic efficiency, energy efficiency and discharge capacity retention of VRFB using bSPI/$MoS_2$-ns membrane are higher than or comparable to those of VRFB using Nafion 117 membrane. And the surfacial morphological integrity of bSPI/$MoS_2$-ns membrane maintains better than reported pristine bSPI

* Corresponding author.
*E-mail address:* zhangyaping@swust.edu.cn (Y. Zhang), Tel./Fax: 86-816-6089372.