Low vanadium permeability membranes based on flexible hydrophilic side chain grafted polybenzimidazole / polymeric ionic liquid for VRFBs

Xiaorui Wang [1] , Shuang Wang [1, 2*], Dan Liang [1], Yinghe Cui [1], Xiaodong Wang [1], Zhipeng Yong [1], Fengxiang Liu [1], Zhe Wang [1, 2,*]

[1] School of Chemical Engineering, Changchun University of Technology, Changchun 130012, China

[2] Advanced Institute of Materials Science, Changchun University of Technology, Changchun 130012, China

*Correspondence: wangshuang@ccut.edu.cn (S.W.); wzccut@126.com (Z.W.)

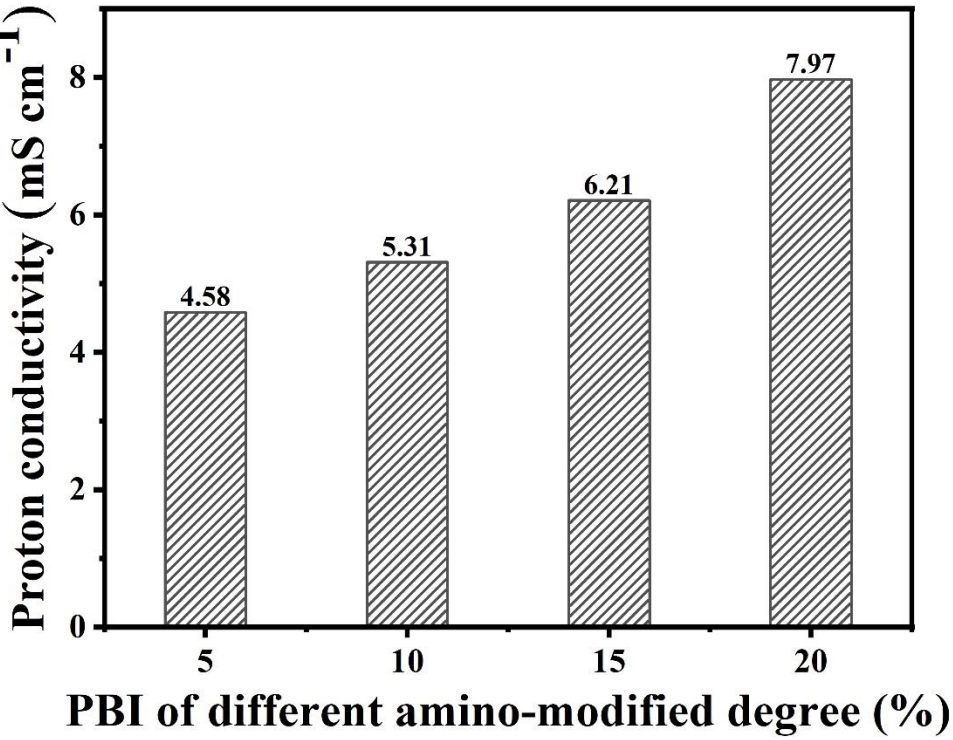

Fig. S1 Proton conductivity of amino PBI membrane (different amino-modified degree is 0.95:0.05, 0.9:0.1, 0.85:0.15, 0.8:0.2).

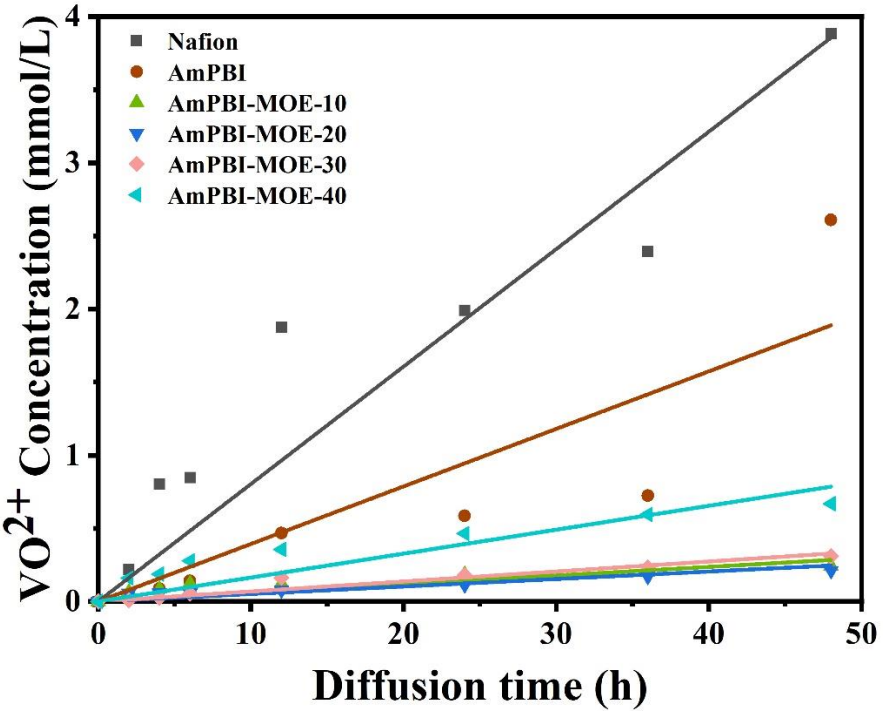

Fig. S2 Vanadium concentration curve of AmPBI-MOE (the degree of graft (DG)= 10 %, 20 %, 30 %, 40 %,).

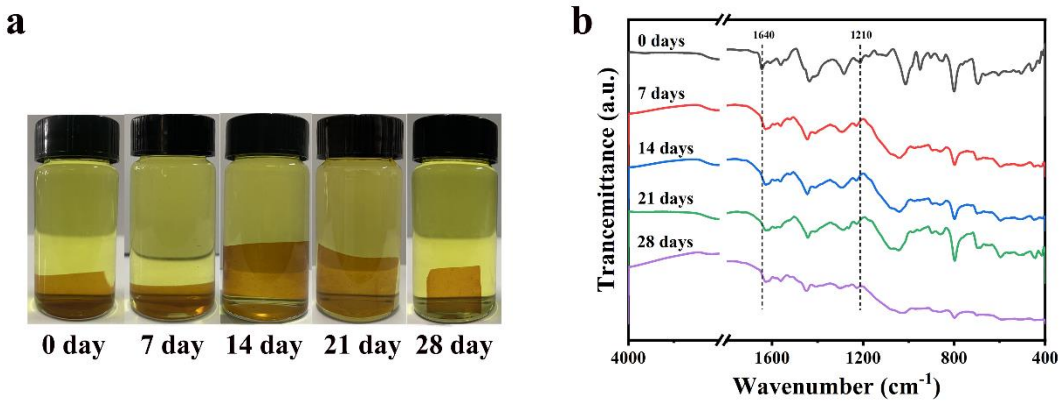

Fig. S3 The oxidative stability of the AmPBI-MOE-PIL-5 membranes.

Thermal stability

Thermogravimetric analysis (TGA) test of all the membranes has been performed to track their thermal stability, and shown in **Fig. S4**. For the pristine AmPBI membrane, the weight loss appeared under the temperature of 550 °C, which is because of PBI chain breakage. About the AmPBI-MOE membranes, new significant weight loss appears at 250-500 °C, which is assigned to the degradation of side chain.

It is known that the thermal stability of PIL is lower than that of the polymer matrix. As the temperature increases, the weight of the composite film gradually decreases due to the decomposition of PIL. However, all the membranes exhibit enough thermal stability to be applied in VRFBs.

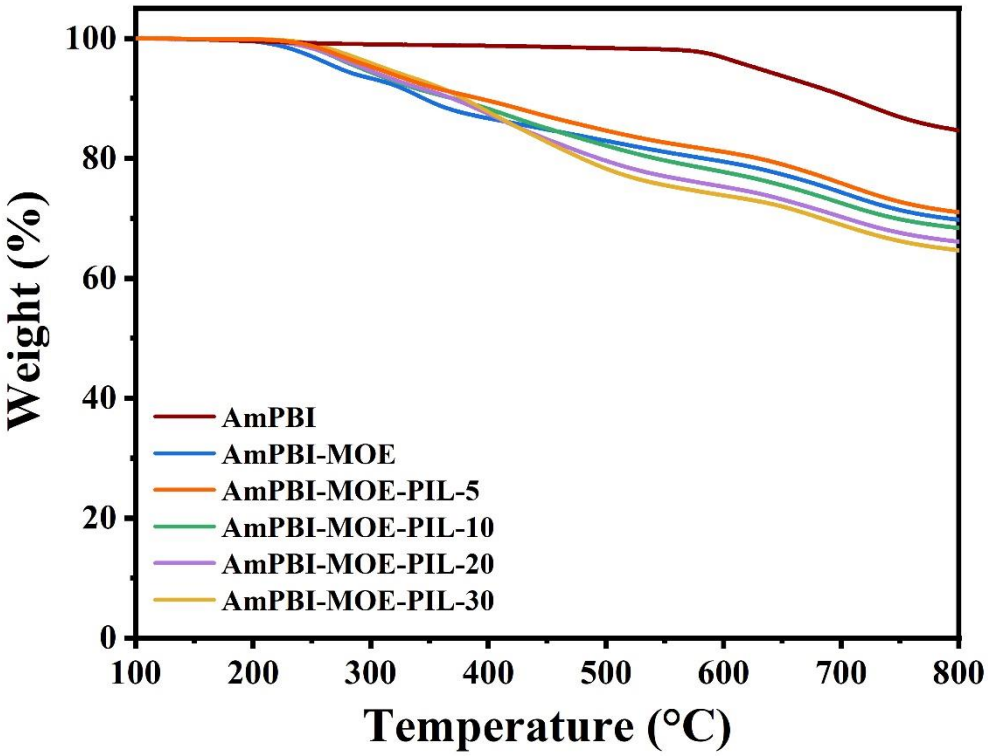

Fig. S4 Thermal stability of composite membranes.