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Nanocomposite anion-exchange membranes for redox flow batteries

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Introduction: The ion-exchange membrane is a vital part of fuel cells, rechargeable batteries, and other electrochemical devices because it determines their efficiency (1). Anion exchange membranes are currently a hot topic of research because they are more efficient and cost-effective in practical applications (2). Organic–inorganic hybrid membranes found to be excellent materials for practical applications due to their improved electrochemical properties, mechanical strength, chemical and thermal stability.

Methods: Layered double hydroxides (LDHs) of Magnesium with Aluminium ([Mg-Al] LDH) were prepared by precipitation at low saturation. 5 wt% PVA solution was prepared. Then a calculated amount of double hydroxide was stirred with PVA solution for 8 hrs and crosslinked using glutaraldehyde. The membranes were characterized by XRD, AC impedance analysis and conducted charge –discharge experiment in redox-flow battery (3).

Results & Discussions: Figure 1 shows the XRD pattern of Mg-Al LDHs. The diffraction pattern of the sample is well correlated with the standard diffraction pattern (ICSD PDF# 54-1030). A Galvanostatic charge–discharge experiment was carried out in a redox-flow battery using the prepared membrane as a separator, as shown in (Figure 2). Over multiple cycles, the results showed above 70% efficiency. This indicates a low level of cross mixing of ions (4).

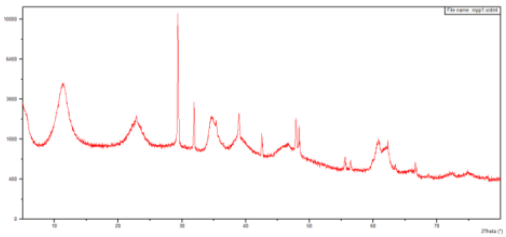

Figure 1. XRD pattern of double hydroxide of Mg-Al.

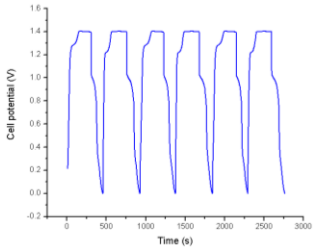

Figure 2. Cell voltage–Time curve of charge–discharge experiment.

Conclusions: We used a co-precipitation method to make nanoparticles of ([Mg-Al] LDH. Its phase purity was revealed by the XRD pattern. The newly fabricated nanocomposite membrane was put to the test as a separator in a redox flow battery. The results of a Galvanostatic charge-discharge test revealed that coulombic efficiency was greater than 70 %.

Keywords: Ion-exchange membrane, Redox-flow battery, Charge–discharge experiment, Hybrid membranes

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