

Synthesis of the *N*-Heterocyclic Chemicals and Their Application as Electrolytes in Non-Aqueous Vanadium Redox Flow Battery

Jun-Hee Ye and Seong-Ho Choi*

Department of Chemistry, Hannam University, Daejeon 305-811, Korea

*Corresponding author. Tel: +82-42-629-8824, E-mail: shchoi@hnu.kr

Abstract: Redox flow batteries (RFBs) are good energy storage systems. The energy in RFBs is saved in two electrolyte solution, in which energy storage species are dissolved. These electrolyte solutions are placed in the separate tanks and are flowed through the battery cell, which is divided by ion-exchange membrane. This membrane prevents the undesirable ion crossover. Two advantages of the RFBs are the almost infinite lifetime of the active species and the independent scalability of power and energy as resulting via design of the battery. The RFBs devices are usually prepared based on vanadium salts as active species in aqueous electrolyte solutions. There are many papers for the aqueous RFBs such as: bromine-polysulfide, iron-chromium, all-vanadium, zinc-bromine, zinc-cerium, and vanadium-bromine. Most of these aqueous RFB systems have the undesirable ion cross-over because of the permeability of membrane, which leads to power and energy loss. Another problem of the aqueous RFB system is the low cell potential because of the aqueous electrolyte solutions. The non-aqueous systems compared to aqueous systems are exhibited the wide potential windows as well as wide temperature range due to the good physical and chemical properties of the non-aqueous electrolyte solution. In spite of the utilization the non-aqueous electrolyte solution in RFBs, a little has been reported that the synthesis of the non-aqueous electrolyte solution for RFBs.

In this study, we synthesized *N*-heterocyclic chemical salts such as [DMPy]⁺[BF₄], [DMPy]⁺[PF₆], [DMP]⁺[BF₄], [DMP]⁺[PF₆], [MPy]⁺[BF₄], [MPy]⁺[PF₆], [DI]⁺[BF₄], and [DI]⁺[PF₆], by counter anion exchange reaction after SN₂ reaction, respectively. We also confirmed the successful synthesized results via ¹H-NMR, FT-IR spectroscopy, and GC-Mass analysis before counter anion exchange reaction. The electric potential of the vanadium acetylacetonate, V(acac)₃, as active species was determined in organic electrolytes in the presence of the synthesized *N*-heterocyclic chemical salts, respectively. The battery performance was practiced in flow single cell device consisted of the commercial Neosepta® AFN as anion exchange membrane in order to know the electrolyte effects such as aromatic and non-aromatic *N*-heterocyclic chemicals.

Keywords: vanadium redox flow battery, non-aqueous, *N*-heterocyclic chemicals