FORMATION AND INVESTIGATION OF BIPOLAR AQUEOUS SODIUM ION BATTERIES

Dovilė Škarnulytė[1], Milda Petrulevičienė[2], Jurga Juodkazytė[2], Linas Vilčiauskas[1,2]

[1]Institute of Chemistry, Vilnius University, Naugarduko 24, LT-03225 Vilnius, Lithuania
[2]Centre for Physical Sciences and Technology, Sauletekio av. 3, LT-10257, Vilnius, Lithuania
dovile.skarnulyte@chgf.stud.vu.lt

Renewable energy is being developed to replace conventional energy sources, contribute to the climate change mitigation programme, and achieve energy independence. Energy storage systems are an integral part of sustainable energy systems. Currently, energy storage systems mostly rely on Li-ion batteries, which are expensive, not environmentally friendly and flammable. Therefore, safer, cheaper and more environmentally friendly batteries are being developed. Aqueous Na-ion batteries are a promising alternative to Li-ion batteries, however, their energy densities are lower due to narrow electrochemical stability window of water [1]. Therefore, bipolar Na-ion batteries are designed, leading to increased voltage of batteries and energy density as well [2]. In this work, sodium vanadium titanium phosphate (NVTP) was used as anode and cathode for the formation of symmetric bipolar NVTP|NVTP coin type cells. Bipolar batteries were assembled using two and three stacked layers, to reach voltage up to 3.6 V. Moreover, electrolytes of two different composition were applied and investigated. In the Fig.1. results of galvanostatic charge discharge cycling of NVTP|NVTP coin type cells containing 2 and 3 stacked layers are presented. Fast capacity fade can be observed, which is mostly due to disbalancing and parasitic reactions issues. Coulombic efficiency, capacity retention and self-discharge time of bipolar NVTP|NVTP batteries were compared.

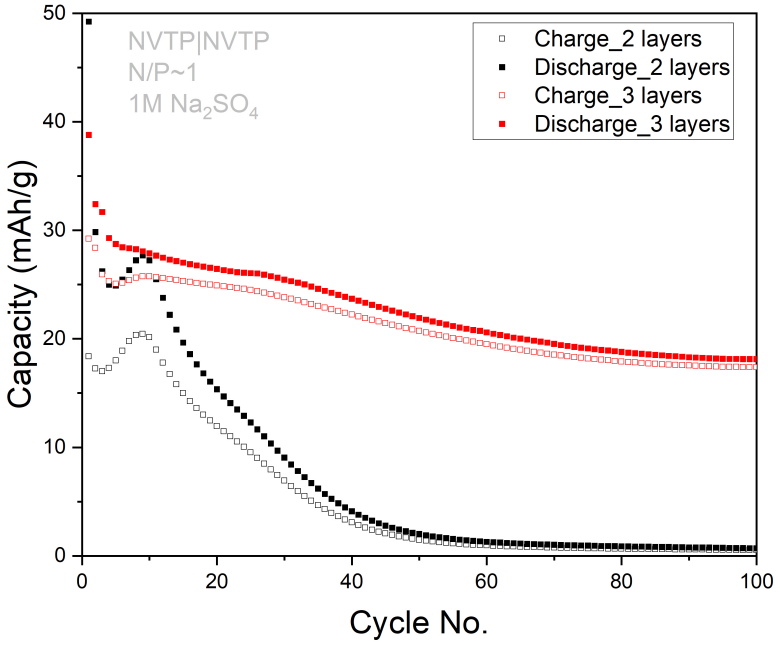

Fig. 1. GCD cycling performance of symmetric NVTP batteries containing 2 and 3 stacked layers in 1M Na_2SO_4 electrolyte at 1C rate

[1] Gintarė Plečkaitytė et al. J. Mater. Chem. A, 2021, 9 , 12670-12683
[2] P. Mohana Sundaram, Chhail Bihari Soni, Sungjemmenla, S.K. Vineeth, C. Sanjaykumar, Vipin Kumar, Journal of Energy Storage, 2023, 63, 107139