Study of the lithium-ion battery at low temperatures

Aiym Mashkeova1, Arailym Nurpeissova2, Zhumabay Bakenov1,2,3, Aliya Mukanova1,2**

1Institute of Batteries, 53 Kabanbay Str., 010000 Nur-Sultan, Kazakhstan
2National Laboratory Astana, 53 Kabanbay Str., 010000 Nur-Sultan, Kazakhstan
3School of Engineering and digital Science, Nazarbayev University, 53 Kabanbay Str., 010000 Nur-Sultan, Kazakhstan

*E-mail: aiym.mashekova@nu.edu.kz
**E-mail: aliya.mukanova@nu.edu.kz

Nowadays, LIBs are one of the most demanded power sources due to their portability, high power and energy density. The performance of LIBs depends on ambient temperature, especially, at low temperatures. According to [1] kinetic reactions rate slows down at low working temperatures, due to physical and chemical electrolyte properties changes, such as viscosity and conductivity etc. The main function of the electrolyte is to transport lithium ions between the electrodes, which slows down due to a decrease in electrical conductivity at a low operating temperature of LIBs. Furthermore, the solid electrolyte interphase (SEI) morphology, components, and formation mechanism have significant impact on the performance of LIB. Therefore, the wide service temperature range and required properties of the electrolyte can be achieved by changing the combination and ratio of solvents, salts and additives.

In present work, two types of lithium-ion cells (CR2032, MTI Corp.) were assembled in Ar-filled glovebox (LABmaster Pro, MBRAUN, <0.1 ppm H2O and O2). The first one was a reference and another one was with electrolyte additive. 1 M LiPF6 (LPF) in ethylene carbonate (EC)/dimethyl carbonate (DMC)/ethyl methyl carbonate (EMC) (1:1:1, by volume) was used as an electrolyte. The modified electrolyte was prepared by adding 3 wt. % acetonitrile (AN) to the above LPF-based electrolyte. Cathode slurry was prepared by mixing LiFePO4 (LFP), acetylene black (AB), and poly(vinylidifluoride) (PVDF) at a weight ratio of 80:15:5 in N-methyl-pyrrolidone (NMP) solvent, lithium metal was used as an opposite and reference electrode. The electrochemical performance of the cells with and without AN additive was investigated at room and low (-30 °C) temperature. All electrochemical cycling test results as well as synthesis routes and characterization details will be presented at the conference.

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References