Positive side of Li-ion battery: An investigation of Cathode and Current Collector

Farheen N. Sayed[a], Marco-Tulio F. Rodrigues[b], Kaushik Kalaga[b], Hemtej Gullapalli[b], Pulickel M. Ajayan[b]

[a] Solid State and Structural Chemistry Unit, Indian Institute of Science, Bengaluru, Karnataka 560012, India

[b] Department of Materials Science and NanoEngineering, Rice University, 6100 Main Street, Houston, TX 77005, United States

Email: farheensayed7@gmail.com

In order to develop a efficient working Li ion cell for extreme temperature operability, polyanion vanado-phosphate electrode is investigated. The structural stability being compromised due to increased detoriation of metal-anion framework was considerably improved with the approach of suitable transition metal substitution in the system. The increased temerapture operability from room temperature to 60 ^{o}C could be achieved with the conventional carbonate based electrolyte. The further increased temerpatre endurance was observed while replacing organic electrolyte with room temperature ionic liquid and imidazolium based LiTFSI salt. However, the encountered electrochemical reactivity of electrolyte and current collected led to the corrosion and its desolating effects on cell performance. Hence, in present study we have done detailed electrochemical studies of different metallic current collectors (Al, Ni, Stainless steel and Hastelloy) for potential support of positive electrode. The dependency of corrosion behavior of these current collectors with different RTILs are studied using chronoamperometry where the change in current and hence electron transfer was monitored, signaling the onset of different surface reactions [1]. Finally, the optimized current collector and electrolyte pair is employed to the pre-screened polyanion vanado-phospate. The designed system with Hastelloy, concentrated piperidinium based electrolyte succeeded in increasing the temperature operability range of positive electrodes v/s Li metal electrode upto 120 ^{o}C while retaining its theoretical capacity, however diminution was observed for room temperature obtained capacity.

References:

[1] F.N. Sayed, M.T.F. Rodrigues, K. Kalaga, H. Gullapalli, P.M. Ajayan, ACS appl materials & interfaces 9 (2017), pp 43623-43631.