

Toward high energy prototype Li-ion batteries with Si-alloy/graphite anode and Ni-rich NMCs cathode

Mario Marinaro¹, Peter Axmann¹, Margret Wohlfahrt-Mehrens¹

¹ZSW, Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg,

Helmholtzstr. 8 D-89081 Ulm, Germany

E-mail: Mario.marinaro@zsw-bw.de

Although the energy of Li-ion batteries has considerably increased over the last two decades, further improvements are expected for next generation of cells. Within the framework of the European project “FiveVB”, it is aimed at the development of high energy prototype Li-ion cells that utilize Ni-rich NMC cathodes and Si-alloy based anodes. The study will first report on the realization and electrochemical characterization of soft-pouch cells with nominal capacity of up to 1.4 Ah. At the anode side, a Silicon-alloy (3M) blended with surface modified graphite (Hitachi) is utilized as active material. Water soluble polyacrylic acid (PAA) is used as the only binder and it demonstrates excellent dispersant and binding properties. Sedimentation and rheological tests show remarkable stability and mostly a thinning behavior of the non-Newtonian type of slurry. The cathode contains Ni-rich NMC (532 or 622, Umicore) as the active material and it is processed in N-Methylpyrrolidone based slurry using polyvinylidene fluoride (Arkema) as the binder. The use of the aforementioned electrode materials allows an increase of the cells’ specific energy of up to 25% when compared to a reference graphite-NMC (532) cell. Furthermore the rate capability of the cells is remarkably improved, with cells being able to retain at 3C over 70% of their slow rate capacity (0.1C). Finally, the cell aging is monitored during the charge/discharge cycling through Electrochemical Impedance Spectroscopy (EIS), whereas post-mortem SEM cross-sectional imaging gives insights on the reasons of the cell failure.

Acknowledgment

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement n° 653531.

Umicore, 3M and Arkema are kindly acknowledged for providing the cathode (NMC 532 and NMC 622), anode (Si-alloy) and binder (PVDF) materials, respectively.