Extending stability of cathode electrode materials in high-voltage region for Li/Na-ion batteries

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To further develop high-energy density Li/Na ion batteries, a feasible strategy is to develop cathode materials is able to work at high-voltage. For example, the upper limit voltage of commercial $LiCoO_2$ has been extended to 4.4 or 4.45(vs. Li). In order to achieve this target, highly stable electrode/electrolyte materials are necessary. In this talk, we will present some results about understanding how to keep high stability of electrode/electrolyte at high voltage with alivolent doping and electrolyte additives.

In the first example[1], suberonitrile (SUN) and LiBOB were investigated as binary additives for Li-ion batteries that used $LiCoO_2$ as a cathode, cycled at high cutoff potentials and utilized $LiPF_6$-based electrolyte. In the electrolyte with binary additives, the electrochemical performance of $LiCoO_2$ was enhanced significantly, and the initial coulombic efficiency increased to 94% compared with 90% in reference electrolyte. The cell also exhibited capacity retention of 62% after 500 cycles, a strong contrast with the 25% measured in reference electrolyte. EIS, SEM, TEM and XPS analyses indicated that the combination of the two additives had a unique influence on the structure and composition of the cathode-electrolyte interface on $LiCoO_2$. Ex situ XRD confirmed that structural change of the $LiCoO_2$ material was not the main reason causing poor cycling performance when charging to the 4.5 V cutoff potential. In addition, some new progress[2] in the controlling cycling stability of P2-type $Na_{0.66}Ni_{0.33}Mn_{0.67}O_2$ with Zn^{2+}-doping and its working mechanism will be also presented.

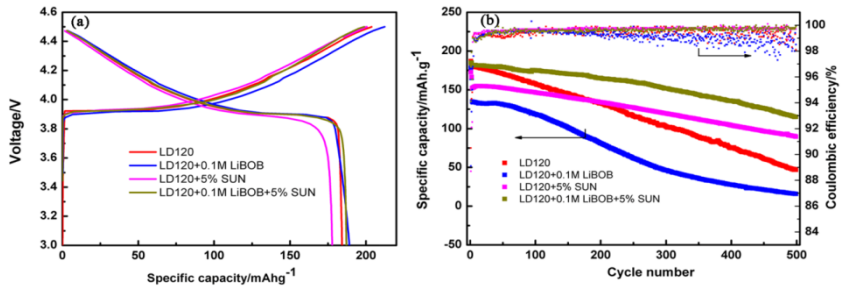

Figure 1.Comparison of (a) the initial voltage profiles at 14 mAg^{-1}, (b) the cycling performance and coulombic efficiencies of $LiCoO_2$/Li half cells at140 mAg^{-1}.

Reference:

[1] Y. Ji, S. Li, G. Zhong, Z. Zhang, Y. Li, M. J. McDonald, Y. Yang *Journal of The Electrochemical Society*. 162 (2015) A7015-A7023.

[2] a) X.H.Wu, J.H.Guo, et al, *J Power Sources*, 281(2015), 18-23; b) X.H.Wu, G.M.Zhong et al; to be submitted