IAS ACERC 2024 International Seminar

Onsite seminar at YNU, Chemistry Bldg. CR108, on Jul. 12th, 2024
14:00 – 15:00

Lecture by Junjie Niu, University of Wisconsin-Milwaukee (UWM)

Title: Ni-Rich $LiNi_{0.8}Mn_{0.1}Co_{0.1}O_2$ with Dual Gradients as Cathode Material in Lithium-Ion Batteries

Abstract: Ni-rich layered materials of $LiNi_{1-x-y}Mn_xCo_yO_2$ ($x+y \leq 0.4$) (NMC) are regarded as promising cathode candidates with a high capacity over 200 mAh/g as well as high voltage of 3.8 V (*vs* Li^+/Li). However, the challenges such as Li^+/Ni^{2+} cation mixing, Li residues, poor thermal stability and pulverization make the battery have limited cycling and rate performance. In particular, the Li^+/Ni^{2+} mixing in $LiNi_{0.8}Mn_{0.1}Co_{0.1}O_2$ (NMC811) cathode material leads to fast battery capacity decay. Here I will talk about our recent work on a dual-gradient Ni-rich layered cathode material (D-NMC811) that was designed by introducing Ni-based metal organic framework of Ni-MOF-74. The formation of protective layer with stable rock salt phase due to the reduced Ni oxidation state on the surface of primary particle resists the internal strain and suppresses the further phase transition, thus alleviating the crack generation. After 300 cycles at 1/3 C, a high half-cell capacity retention of 88.50% with 0.038% decay per cycle was received. The full-cell battery displayed a high-capacity retention of >86.7% with a Coulombic efficiency (CE) of >99.86% at 1/3 C after 300 cycles. The 300 mAh pouch cell delivered an energy density of 216.4 Wh/kg. After 500 cycles at 1.0 C, it still displayed 84.1% capacity retention while the battery with conventional NMC811 only had a capacity retention of 53.0% after 400 cycles.

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