The Electrochemical Degradation Mechanism and Thermal Behaviors of the Stored $LiNi_{0.5}Co_{0.2}Mn_{0.3}O_2$ Cathode Materials

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The degradation mechanism of the stored $LiNi_{0.5}Co_{0.2}Mn_{0.3}O_2$ (NCM523) electrode has been systematically investigated by combining physical and electrochemical tests. After stored at 55 °C and 80% relative humidity (RH) for 4 weeks, the NCM523 materials are coated with a layer of impurities containing adsorbed species, Li_2CO_3 and LiOH, resulting in the weight gains. The impurities will react with the electrolyte and turn into $Li_xPO_yF_z$ (or LiF) and other species containing the decomposition products of electrolyte when the stored NCM523 materials are soaked into the electrolyte, causing a higher impedance and charge potential plateau. For the stored NCM523 electrodes, the discharge capacity will rapidly decay as a result of the huge and changeable impedance in the first 10 cycles, which will slowly recover and stabilize within 10 cycles when charging/discharging at 0.1 C or 0.2 C. The thermal stability of the stored NCM523 materials get slightly better due to the relatively low delithiated state after charged to 4.3 V.

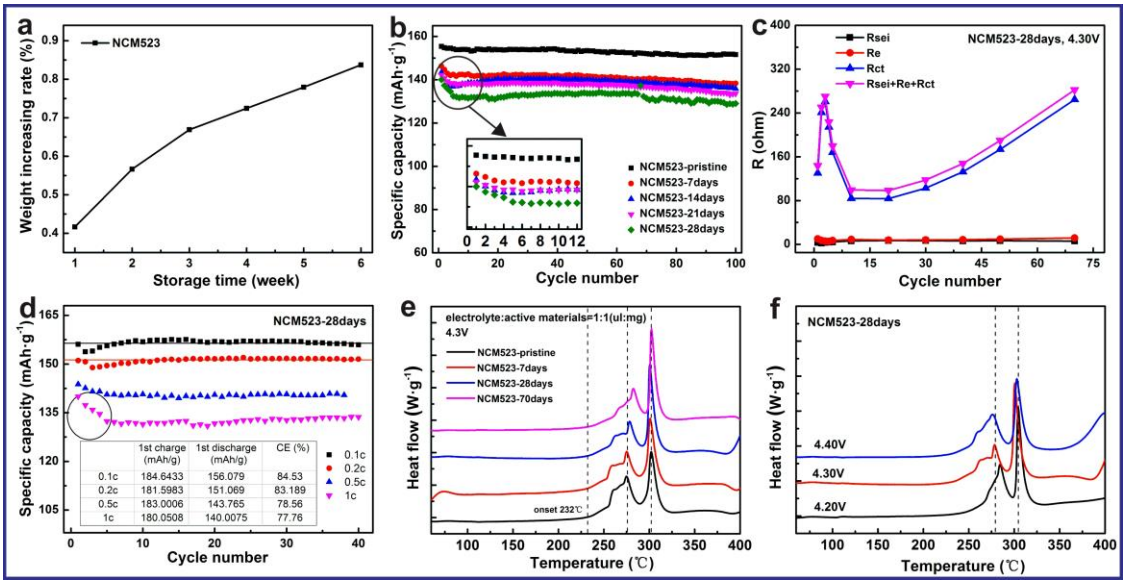

Figure 1 (a) The weight increasing rate of the stored and pristine NCM523 materials. (b) Cycle performance for the pristine and stored NCM523 materials. (c) Fitting data of Nyquist plots for NCM523-28days. (d) The specific discharge capacity of the NCM523-28days at 1 C, 0.5 C, 0.2 C and 0.1 C. DSC profiles: (e) pristine and stored NCM523 at charged state, (f) NCM523-28days after charged to 4.2V and 4.4V

References:

[1] H. Liu, Y. Yang, J. Zhang, J. Power Sources, 162 (2006) 644-650.
[2] Z. Chen, J. Wang, J. Huang, J. Zhao, et al. J. Power Sources, 363 (2017) 168-176.