Electrochemical Behavior of 3,4-ethylenedioxythiophene as an Anti-overcharge Additive for Lithium-ion Batteries

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The overcharge protection performance of $\text{LiNi}_{0.8}\text{Co}_{0.1}\text{Mn}_{0.1}\text{O}_2$ as the positive electrode materials for the lithium-ion batteries is significantly enhanced by adding 3,4-ethylenedioxythiophene (EDOT) into the electrolyte. The effect of anti-overcharge on $\text{LiNi}_{0.8}\text{Co}_{0.1}\text{Mn}_{0.1}\text{O}_2$ electrodes are analyzed by microelectrode linear scan voltammetry measurement, electrochemical impedance measurement, constant current charge/discharge and overcharged tests. The cycled electrodes are also tested by scanning electron microscopy (SEM) and X-ray diffraction (XRD) analysis. The results show that the EDOT additive can react with the base electrolyte and easily form a polymer layer on the surface of $\text{LiNi}_{0.8}\text{Co}_{0.1}\text{Mn}_{0.1}\text{O}_2$ electrodes at a stable platform of 4.4 V (vs Li/Li^+). The time for the voltage rising to the overcharge state is apparently delayed from 25 h to 58 h. After 100 cycles at 0.5 C rate, the capacity retention rate of the half-cell is increased from 80.1% to 93.4% after adding the EDOT additive. The results demonstrate that this promising anti-overcharged and cyclic performance are attributed to the protective film generated by EDOT which may enhance the interfacial stability of $\text{LiNi}_{0.8}\text{Co}_{0.1}\text{Mn}_{0.1}\text{O}_2$ /electrolyte.

Keywords: 3,4-ethoxylenedioxythiophene, electrolyte additive, overcharge, $\text{LiNi}_{0.8}\text{Co}_{0.1}\text{Mn}_{0.1}\text{O}_2$, lithium-ion batteries

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