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Enhanced performance of $LiNi_{0.03}Mo_{0.01}Mn_{1.96}O_4$ cathode materials coated with biomass-derived carbon layer

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ABSTRACT

A high-performance Ni/Mo co-doped lithium manganate composite material, $LiNi_{0.03}Mo_{0.01}Mn_{1.96}O_4$, is prepared by a solid-state method, then a biomass-derived carbon layer with ethyl cellulose as the carbon source is applied to the surface of the composite particles. We find that carbon layer with the proper loading can significantly enhance the material's cyclic stability and capacity at high discharge rates. At rates of 5C and 10C, our optimal sample (LNMMO-3wt%C), with 3 wt% carbon layer loading, has discharge capacities up to 114 and 98 mAh g^{-1}, respectively, which are 10 and 8% higher than those of the uncoated co-doped material. Further, the carbon layer coating significantly improves the material's stability at high discharge rates: the capacity retention of LNMMO-3wt%C after 400 cycles at discharge rates of 5C and 10C is high reaching 93.6 and 88.1%, respectively, compared with 91.4 and 74.3% for uncoated LNMMO. Based on our experimental results and analysis, we attribute the enhanced stability and capacity at high discharge rates to two factors: (i) enhanced conductivity and (ii) reduced Mn^{3+} dissolution, combined with significantly decreased resistance from Li^+ ion intercalation/de-intercalation, due to the uniformity of the carbon layer coating.