High-voltage performance cathode material with simultaneous MgO coating and Mg doping for practical Sodium-Ion Batteries

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Encouraged by previously conducted research activities in this field, we have adopted an effective strategy for simultaneous MgO coating and Mg doping to produce substantially improved high voltage stability compared to the previously reported results in the literature on $Na[Ni_{0.5}Mn_{0.5}]O_2$ cathodes. The MgO coating layer effectively suppressed the unfavorable side reactions during cycling while the partial Mg doping into the bulk Ni sites improved the structural stability by moderating the extent of the irreversible multiphase transformation. As a result, the combination of a MgO coating with Mg doping provides enhanced electrochemical performance and structural stability of $Na[Ni_{0.5}Mn_{0.5}]O_2$ within the voltage range of 2.0–4.2 V. The practical acceptability of the simultaneous MgO coating and Mg doping of the $Na[Ni_{0.5}Mn_{0.5}]O_2$ cathode was obviously verified using scaled-up pouch-type full cells with hard carbon anodes. Moreover, the use of earth's abundant and inexpensive Mg and Na elements, and a simple practical strategy are highly desirable for developing high-energy and low-cost SIBs.