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Conversion of electrolytic MnO2 to Mn3O4 nanowires for high-performance anode materials for lithium-ion batteries

Nithyadharseni Palaniyandy; Funeka P. Nkosi; Kumar Raju; Kenneth I. Ozoemena

Abstract:
A simple and versatile approach has been implemented for the preparation of some manganese oxide (MnxOy)-based lithium-ion battery anode materials from low-cost electrolytic manganese dioxide (EMD). Depending on the additive, calcination temperature and time used in the preparation, the raw EMD exhibits different nano−/micro-structure morphologies, confirmed from X-ray diffraction (XRD) and field-emission scanning electron microscopy (FE-SEM). The specific capacity (obtained at 100 mA g−1) of the MnO2 nano-rods/wires, Mn2O3 nano-particles and Mn3O4 of mixed morphology (i.e., nano-rods/wires and nanoparticles) were approximately 710, 830 and 850 mAh g−1, respectively. Of the various MnxOy investigated, the Mn3O4 nanowires obtained at 600°C within 2 h showed enhanced rate capability properties, long-term cycling stability and the best Li-ion and electronic transportation, suggesting that the formation of the solid-electrolyte interphase (SEI) film during the first cycle protected these anode materials against possible electrolyte decomposition. The high-performance of this Mn3O4 anode material is ascribed to its 1-D nanostructures (nano-rods/wires) which confers on it high aspect ratios, large pore size as well as the ability to serve as efficient electron transport channels or interconnects. This study provides the first insight into the viability of Mn3O4 as an anode material for lithium-ion battery, and opens doors of opportunity for the development of energy storage materials from the low-cost EMD precursor.