Electrochemical Impedance Spectroscopy Study Analysis of MnO_2 for High-Performance Aqueous Zn-Ion Batteries

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The zinc ion battery (ZIBs) has gained much interest recently due to its low cost, abundance in nature, non-toxicity, mature processing technology, high volumetric energy density, compatibility with aqueous electrolytes, etc. One of the main challenges in developing zinc ion batteries is a suitable cathode material with good capacity and structural stability. Electrochemical impedance spectroscopy (EIS) has been widely used as a non-destructive technique to understand the dynamic processes inside a battery. Because of the ease of using and analyzing the impedance spectra, the EIS can be applied in diverse fields of electrochemical systems. Thus, the EIS technique helps to understand the electrochemical mechanisms at the electrified interface in a single measurement. In general, it measures resistance (R), capacitance (C), and inductance (L) by monitoring the current response while an AC voltage is applied to an electrochemical cell. With this method, one can recognize and estimate the importance of different processes in an electrochemical process of a battery to prevent battery failure and diagnose the cells. MnO_2 has shown great potential as cathode material for zinc ion battery systems in aqueous systems compared to other metal oxides. In this study, we synthesized MnO_2 using a hydrothermal method and followed by annealing it in an Argon atmosphere at 300 ºC for 4 h to enhance the structural stability of the sample. EIS is done after each charge and discharge of the cell to understand the change in the internal resistance after each charge and discharge cycle. Therefore, the EIS analysis determines the critical information at the electrode-electrolyte in the ZIBs.

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