Preparation and Characterisation of Battery-grade $\text{Na}_2\text{Mn}_3\text{O}_7$ as a Cathode Material from Manganese Ore

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Natural battery-grade manganese dioxide with 69.78 mass% MnO_2 and 14.50% MnCO_3 was subjected to solid-state treatment to prepare a hybrid system with $\beta\text{-MnO}_2$ and $\text{Na}_2\text{Mn}_3\text{O}_7$ phases. The heat treatment was carried out at 400°C using NaOH/MnO_2 molar ratios ranging 0.4 to 1.2 and $\text{NaNO}_3/\text{MnO}_2$ molar ratios ranging 0 to 0.8. The structures of the samples were analysed using X-ray diffraction and differential scanning calorimetry. The electrochemical properties were evaluated through cyclic voltammetry, and the specific capacitance (C_s) values were calculated. The XRD results confirmed the formation of $\text{Na}_2\text{Mn}_3\text{O}_7$. The highest C_s (34.21 F g⁻¹) was obtained in the sample with 24.15 mass% $\text{Na}_2\text{Mn}_3\text{O}_7$. A thermodynamic analysis was also carried out to estimate the effect of the NaOH and NaNO_3 contents and of the temperature on the formation of Mn-based species.

Keywords: solid state treatment; $\text{Na}_2\text{Mn}_3\text{O}_7$ species; specific capacitance.

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