Enhancing the Rate Capability of the Ni-Co-O System Electrode Using NH3 Treatment

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In recent years, the global energy crisis and climate change have become serious issues in need of innovative solutions, so exploring new renewable energy resources is the primary objective of many researchers worldwide. As a result, supercapacitors have attracted extensive attention as promising energy storage and delivery devices due to their fast charge and discharge rate, high power density (1-2 orders of magnitude greater than that of batteries), and long cycle life (2-3 orders of magnitude greater than that of batteries). Most commercial supercapacitors are carbon based electrochemical double layer capacitors (EDLC) that store charge at the electrode and electrolyte interface. However, their energy densities are lower than those of pseudocapacitors, another category of supercapacitors that store charges using reversible faradic redox reactions. Ternary oxide pseudocapacitor systems, such as Ni-Co-O, etc. have exhibited excellent capacitive behaviors. They can provide richer redox reaction sites than their monoxide counterparts (NiO, CoO, etc.) and therefore have the possibility of producing higher specific capacitances. Unfortunately, they still suffer from low conductivity and as a result, poor rate capability. In this study, I aim to develop a ternary oxide pseudocapacitor system using Ni-Co-LDH as a precursor treated with an NH3 atmosphere at various temperatures to improve its conductivity and rate capability. I found that the NH3 treated Ni-Co-O system electrode shows an enhanced rate capability with only a 14.008% loss of capacitance over the current density range of 2-20 A/g while still maintaining high specific capacitances above 500 F/g. The assembled asymmetric supercapacitor using my electrode coupled with graphene also shows good capacitive behaviors.

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