Thin chemisorbed polyaniline film on cobalt oxide as an electrode for hybrid energy storage devices

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ABSTRACT

Electrical charge storing electrodes and their surface modification are intensively investigated to improve the charge storability indicators in electrochemical energy storage devices. Here, the effects of a thin chemisorbed polyaniline (PANI) film on the charge storage behavior of rod-shaped spinal-type cobalt oxide (Co_3O_4) nanorods (PANI@Co_3O_4) are detailed for fabrication of battery–supercapacitor hybrid (BSH) devices. The PANI@Co_3O_4 showed larger surface area and optimum porosity properties, which contributed to ~50 % enhanced specific charge than that in the Co_3O_4. The deconvoluted total charge storage gain showed more contribution to the bulk-diffusion controlled process (battery-type), lower ion transport resistance and Warburg impedance in the PANI@Co_3O_4 electrode than that in the Co_3O_4. Two-sets of BSH devices are fabricated using PANI@Co_3O_4 as a positive electrode and mesoporous carbon (MC) and activated carbon (AC) negative electrodes in an aqueous electrolyte and benchmarked with symmetric supercapacitors fabricated using the two carbons. The PANI@Co_3O_4//MC device showed nearly two-fold higher specific energy (E_S) than that of PANI@Co_3O_4//AC. Interestingly, AC//AC symmetric supercapacitors showed two-fold higher E_S than the MC//MC device. Origin of differences in the charge storage behavior of the two types of devices are systematically analyzed and reported.

KEYWORDS

Chemisorption; Electrochemical energy storage; Mesoporous materials; Polymer-nanocomposites; Pseudocapacitors

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