A facile strategy to synthesis graphene-wrapped nanoporous copper-cobalt selenide hollow spheres as an efficient electrode for hybrid supercapacitors

By: Moosavifard, SE (Moosavifard, Seyyed Ebrahim)[1,2]; Mohammadi, A (Mohammadi, Abdolkhaled)[3]; Darzi, ME (Darzi, Mohammad Ebrahimnejad)[3]; Kariman, A (Kariman, Asadollah)[4]; Abdi, MM (Abdi, Mahnaz M.)[3]; Karimi, G (Karimi, Gholamreza)[3]

Abstract

Increasing demands from the electronics industries for fast energy storage devices motivate scientists to spend a tremendous time to design and optimize electrode materials. However, optimizing the full charge cycle requires a highly efficient electrochemical performance that depends on the smart morphological and structural design of the metal compounds and achieving the right chemical composition by taking into consideration the synergistic effect between different elements and the structure effect. Energy storage systems can benefit from the use of Ternary Transition Metal Selenide (TMSe) electrodes; however, the applicability and electrochemical efficiency of these electrodes are hampered by their low active surface area and conductivity. Constructing carbonate materials by introducing binary metal atoms, as well as designing a hollow structure at the nano- and microscales could efficiently overcome these limitations. In this study, we designed a facile self-template approach to preparing porous hollow copper-cobalt selenide microspheres wrapped on conductive networks of reduced graphene oxide (rGO-CCSe). The synthesized electrode is capable of providing considerable capacity retention of 91.5% after 6000 charge cycles through smart structural design and by taking advantage of the bimetallic synergy at the atomic level, with an extremely high specific capacitance of 724 C g-1 at 2 A g-1. Besides, we fabricated an asymmetric cell by using the rGO-CCSe hollow microsphere electrode to achieve very high values for energy densities (57.8 Wh kg-1). The graphene conductive support along with the battery-type CCSe cubics creates a synergistic effect, which accounts for such a remarkable electrochemical output from the rGO-CCSe electrode. In this study, we propose a novel approach to make highly efficient electrodes that can effectively enhance the performance of hybrid supercapacitors used in modern electronic devices.

Keywords

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