Cobalt-molybdenum selenide double-shelled hollow nanocages derived from metal-organic frameworks as high performance electrodes for hybrid supercapacitor

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Abstract:

In this paper, we developed a sequential chemical etching and selenization processes to synthesize Co-MoSex double-shelled hollow nanocages (CMS-DSHNCs) as high performance electrode materials for supercapacitor applications. Co-MoOx yolk-shelled hollow nanocages were firstly synthesized using a solvothermal process through facile ion-exchange reactions between zeolitic imidazolate framework-67 (ZIF-67) and MoO42- ions. By applying a solvothermal temperature of 160 °C in the presence of SeO32- and subsequently annealing strategy, CMS-DSHNCs were successfully synthesized with a yolk-shell hierarchically hollow and porous morphology of mixed metal selenides. The CMS-DSHNCs exhibit superior electrochemical properties as electrode materials for supercapacitor: e.g., a specific capacity of 1029.8C g−1 at 2 A g−1 (3.089C cm−2 at 6 mA cm−2), a rate capability of ~ 76.14%, a capacity retention at 50 A g−1, and a good cycle stability (95.2% capacity retention over 8000 cycles). A hybrid supercapacitor was constructed using the CMS-DSHNCs as the cathode and activated carbon (AC) as the anode in a solution of 3 M KOH, and achieved a high specific energy of 45 Wh kg−1, and a specific power up to 2222 W kg−1 with a good cycling stability of 94% after 8000 cycles.

Keywords: Capacitive-type electrode, Double-shelled and hollow nanocages, Co-MoSex, Asymmetric supercapacitor