Rational Design of Nb_2O_5@Carbon Core-Shell Nanocrystals and Reduced Graphene Oxide Nanocomposites as High-Performance Sodium-Ion Hybrid Supercapacitor Anode Materials

임은호, 이진우[1,†]
포항공과대학교; [1]포항공과대학교 화학공학과
(jinwoo03@postech.ac.kr[†])

Sodium-ion hybrid supercapacitors (Na-ion HSCs) have potential for mid- to large-scale energy storage applications because of their high energy densities within seconds, stable cycle performance, and low cost of sodium. However, one of the problems to developing high-performance Na-ion HSCs is kinetics imbalance from different charge storage behaviors between sluggish Faradaic anode (Na-ion battery type) and rapid non-Faradaic capacitive cathode (EDLC type). Therefore, to develop high-rate Na-ion HSC anode materials, this work reports the facile synthesis of nanocomposites composed of Nb_2O_5@Carbon core-shell nanocrystals (Nb_2O_5 @C NCs) and reduced graphene oxide (RGO), and an analysis of their electrochemical behavior. In a Na half-cell test, the Nb_2O_5@C/RGO delivers capacity of ~285 mA h g^{-1} at 0.025 A g^{-1} in the voltage range of 0.01-3.0 V (*vs.* Na/Na^+). Moreover, the Na-ion HSC using the Nb_2O_5@C/RGO anode and commercial activated carbon cathode shows high energy density (~76 W h kg^{-1}) with high power density (~20,800 W kg^{-1}) in the voltage range of 1.0-4.3 V.