Abstract #549, 223rd ECS Meeting, © 2013 The Electrochemical Society

Intertwined carbon-MnO_2 nanowire hybrid nanostructure foam for high energy supercapacitors

Wei Wang[1, 3], Shirui Guo[2], Mihrimah Ozkan[2,3], Cengiz S. Ozkan[1, 4]
[1] Program of Materials Science and Engineering, University of California, 900 University Ave., Riverside, CA 92521, USA.
[2] Department of Chemistry, University of California, 900 University Ave., Riverside, CA 92521, USA
[3] Department of Electrical Engineering, University of California, 900 University Ave., Riverside, CA 92521, USA
[4] Department of Mechanical Engineering, University of California, 900 University Ave., Riverside, CA 92521, USA

Rapidly charged and discharged supercapacitors are very promising alternative energy storage systems for applications in portable electronics and electric vehicles. Integration of pseudocapacitve metal oxides with single-structured materials receives a lot of attention recently due to superior electrochemical performances of these materials. Here, in order to realize high energy density supercapacitors, we described a simple and scalable method to prepare graphene/MWNTs/MnO_2 nanowires (GMM) hybrid nanostructure foam via a scalable two-step process. The 3D graphene/MWNTs (GM) foam was grown on foamed metal foils (nickel foam) via an ambient pressure chemical vapor deposition (APCVD). Hydrothermally synthesized MnO_2 nanowires are conformally coated on the GM foam by a simple bath deposition. The as-prepared hierarchical GMM foam yields monographical graphene foam conformally covered with intertwined, densely packed CNT/MnO_2 nanowire nanocomposite network which possesses a high surface area. Symmetrical electrochemical capacitors (ECs) based on GMM foam electrodes show an extended operational voltage window of 1.6 V in aqueous electrolyte (Figure 1-2). A high specific capacitance (1101.65 F g^{-1}) is achieved. Moreover, the great capacitance retention (~100%) after 13000 charge-discharge cycles and high current handability demonstrate the high stability of the material for electrodes of supercapacitor. These excellent performances enable the innovative 3D hierarchical GMM foam to serve as EC electrodes, resulting in energy storage devices with high stability and power density in neutral aqueous electrolyte.

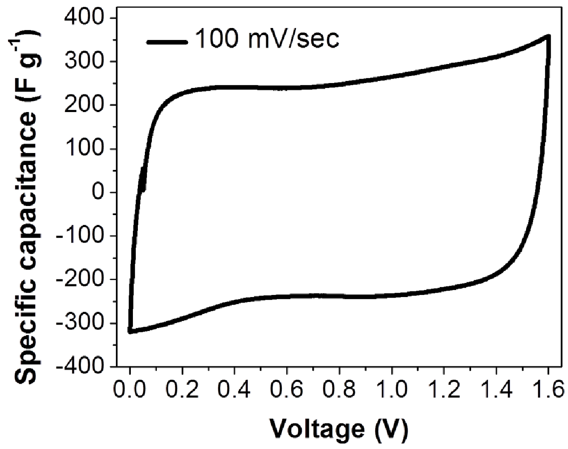

Figure 1. Normalized CV curve for GMM foam. Scan rates: 100 mV/sec.

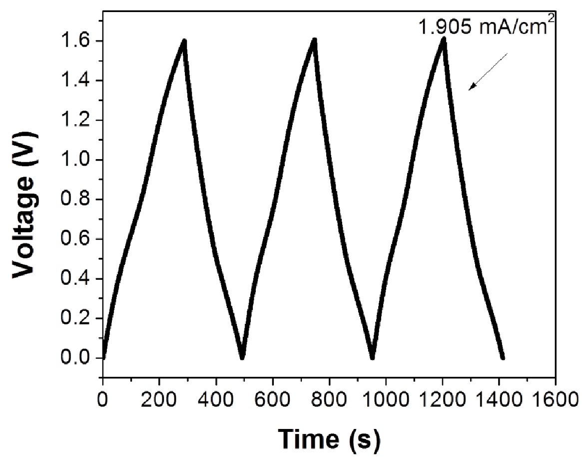

Figure 2. Galvanostatic charge-discharge (CC) curves of a GMM supercapacitor at a current density of 1.905 mA cm^{-2}.