3D Vanadium Oxides@Polypyrrole Nanostructured Arrays for Asymmetric Supercapacitors

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There is currently a great interest in the development of thin, flexible, lightweight, and environmentally friendly supercapacitors as the booming of Smartphones and electronic devices. In our research, a supercapacitors electrode composed of well-aligned V3O7 nanorod array grown on 3D nickel foam with polypyrrole (PPy) immobilized was invented. The electrode architecture takes advantage of the high electrochemical activity from both the V3O7 and PPy, the high electronic conductivity of PPy, and the short ion diffusion pathway in ordered mesoporous nanorod array. V3O7 nanorod array were grown on the nickel foam by template/surfactant-free hydrothermal method, followed by immobilization of PPy. Nanostructured morphology and crystallinity of as-prepared materials were examined and confirmed by SEM and XRD analysis, as V3O7·H2O (JCPDS 85-2401). Asymmetric-solid state supercapacitor fabricated by using V-3O7@PPy hybrid array as negative electrode and MnO2@PPy as the positive electrode has demonstrated high capacitance (192 Fg-1), high energy density (20.9 Wh kg-1) and outstanding capacitance retention of 92% after over 20,000 cycles. Superior electrochemical performance of metal oxides@PPy nanorod array can be attributed to the large accessible surface area of the ordered mesoporous nanorod array structure and low interfacial resistance. It is believed that this is the first report of the design and development of the 3D vanadium oxide based nanostructured arrays for asymmetric supercapacitors.