Synthesis and characterisation of graphite oxide/vanadate nanowire composites

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Abstract

There is a growing interest in composites composed of vanadium-oxides and carbon nanostructures due to their promising electrochemical properties. These composite materials are potential candidates for application as electrode materials in Li-ion batteries and supercapacitors [1,2]. The latter have thousand times higher specific capacity than conventional electrolytic capacitors, while its performance deteriorates only slightly during hundreds of charge-discharge cycles.
In our study vanadate nanowire – graphite oxide composites were synthesized via the hydrothermal route. The influence of adding graphite oxide to the composite on the electrochemical performances was investigated. The morphology, structure and interaction between components were studied by transmission and scanning electron microscopy (TEM, SEM), Raman spectroscopy, X-ray diffractometry (XRD) and energy dispersive X-ray spectrometry (EDS). The electrochemical properties were examined by the galvanostatic charge-discharge method, cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). The specific capacity, energy and power density of the capacitor constructed from the vanadate/graphite oxide composites were determined and their dependence on the amount of added graphite oxide was discussed.

Results revealed that a hybrid type supercapacitor was formed. The specific capacities determined from cyclic voltammetry and galvanostatic charge-discharge method were in good agreement and were found to increase monotonously between 210 and 270 F/g with increasing amount of graphite oxide. The energy density of the capacitor changed from 19 to 25 Wh/kg with the graphite oxide content, however, power density turned out to be independent of the graphite oxide amount at around 410 W/kg. These values are in good agreement with literature data. On the other hand, the mechanism responsible for the considerable deterioration of specific capacity during repeated charge-discharge cycles is yet to be resolved.

References

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