Pseudocapacitive charge storage in thin nanobelts

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ABSTRACT

This article reports that extremely thin nanobelts (thickness ~ 10 nm) exhibit pseudocapacitive (PC) charge storage in the asymmetric supercapacitor (ASC) configuration, while show battery-type charge storage in their single electrodes. Two types of nanobelts, viz. NiO–Co_3O_4 hybrid and spinal-type $NiCo_2O_4$, developed by electrospinning technique are used in this work. The charge storage behaviour of the nanobelts is benchmarked against their binary metal oxide nanowires, i.e., NiO and Co_3O_4, as well as a hybrid of similar chemistry, CuO–Co_3O_4. The nanobelts have thickness of ~ 10 nm and width ~ 200 nm, whereas the nanowires have diameter of ~ 100 nm. Clear differences in charge storage behaviours are observed in NiO–Co_3O_4 hybrid nanobelts based ASCs compared to those fabricated using the other materials—the former showed capacitive behaviour whereas the others revealed battery-type discharge behaviour. Origin of pseudocapacitance in nanobelts based ASCs is shown to arise from their nanobelts morphology with thickness less than typical electron diffusion lengths (~ 20 nm). Among all the five type of devices fabricated, the NiO–Co_3O_4 hybrid ASCs exhibited the highest specific energy, specific power and cycling stability.

KEYWORDS

Battery-supercapacitor hybrid devices; Energy storage materials; Hybrid materials

ACKNOWLEDGEMENT

This work is supported by the Research and Innovation Department of University Malaysia Pahang (http://ump.edu.my) under the Flagship Leap 3 Program (RDU172201).