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Three dimensional vanadium pentoxide/graphene foam composite as positive electrode for high performance asymmetric electrochemical supercapacitor

Ndeye M. Ndiaye^a, Balla D Ngom^b, Ndeye F. Sylla^a, Tshifhiwa M. Masikhwa^a, Moshawe J. Madito^a, Damilola Momodu^a, Tshepo Ntsoane^c and Ncholu Manyala^{a*}

^aDepartment of Physics, Institute of Applied Materials, SARChI Chair in Carbon Technology and Materials, University of Pretoria, Pretoria 0028, South Africa.

^bLaboratoire d'Energie, de Photonique et de Nano-Fabrication, Faculté des Sciences et Techniques Université Cheikh Anta Diop de Dakar (UCAD) B.P. 25114 Dakar-Fann Dakar, Senegal

^cNuclear Energy Cooperation South Africa, Nuclear Liabilities Waste Management, Pelindaba, South Africa

*Corresponding author's email: ncholu.manyala@up.ac.za, Tel.: + (27)12 420 3549;

Fax: + (27)12 420 2516

Abstract

The electrochemical performance of hydrothermal synthesized three dimensional (3D) orthorhombic vanadium pentoxide (V_2O_5) nanosheets and vanadium pentoxide/graphene foam (V_2O_5 /GF) composites at different mass loading of GF were successfully studied. The optimized V_2O_5 /GF-150 mg composite provided a high specific capacity of 73 mA h g^{-1} , which was much higher than that the pristine V_2O_5 (60 mA h g^{-1}) nanosheets at a specific current of 1 A g^{-1} . A hybrid capacitor was also fabricated by adopting a carbon-based negative electrode obtained from the pyrolysis of an iron-PANI polymer (C-Fe/PANI) mixture and the 3D V_2O_5 /GF-150 mg composite as the positive electrode in 6 M KOH electrolyte. The hybrid device of V_2O_5 /GF-150 mg//C-Fe/PANI demonstrated a high energy density of 39 W h kg^{-1} with a corresponding high power density of 947 W kg^{-1} at a specific current of 1 A g^{-1} in an operating voltage window of 0.0 - 1.6 V. The hybrid device also exhibited an excellent cycling stability with 74% capacity retention recorded for up to 10000 constant charging–discharge cycles and an excellent ageing test at a specific current of 10 A g^{-1} .

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