Novel green biosynthesis of vanadium pentoxide by the extraction of the white hibiscus sabdariffa leaves as electrode material for supercapacitor applications

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Abstract

A novel green biosynthesis of the vanadium pentoxide@white hibiscus sabdariffa (V_2O_5@WHS) nano-flowers-like structures was successfully synthesized by solvothermal method. The X-ray diffraction analysis of the materials revealed the orthorhombic structure V_2O_5. No other peaks from the white hibiscus sabdariffa were observed in the XRD pattern which revealing the high phase purity of the V_2O_5@WHS material. The X-ray photoelectron spectroscopy spectrum of the materials exhibited the presence of V^{3+}, V^{4+} and V^{5+} in the binding energies of the V_2O_5@WHS. The electrochemical performance of the electrode material was evaluated using a 6 M KOH aqueous electrolyte. The specific capacity of the V_2O_5@WHS reached a value of 50.4 mA h g^{-1} at a current density of 0.5 A g^{-1}. An asymmetric capacitor was also fabricated by adopting an activated carbon negative electrode obtained from the peanut shell waste as raw material and the V_2O_5@WHS as the positive electrode in 6 M KOH electrolyte. The hybrid capacitor of V_2O_5@WHS//AC displayed a high energy density of 33 W h kg^{-1} with a corresponding high power density of 470 W kg^{-1} at 1 A g^{-1} in a large voltage window of 0.0 - 1.7 V. The device also exhibited an excellent cycling stability with 87% capacity retention recorded for up to 20.000 constant charging–discharge cycles and an excellent ageing test at a specific current of 10 A g^{-1}.

Keywords: Hibiscus sabdariffa, Green Biosynthesis, Vanadium Pentoxide, Asymmetric Supercapacitors

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Biography

Balla Diop Ngom, Nanomaterial's scientist, originally from the West African country of Senegal, holds a PhD degree in nanomaterials synthesis and characterization from the University Cheikh Anta Diop of Dakar (UCAD), Dakar, Senegal. He pursue a second PhD with the University of the

Western Cape (UWC), Cape Town, South Africa. He is as Associate Professor and Director of the Quantum Photonic, Energie & NanoFabrication. Prof Ngom is a Future Leaders – African Independent Research (FLAIR, a project funded by the Royal Society of UK in partnership with the African Academy of Sciences. His research activities include: Nanomaterials and Smart materials, natural pigments and dyes, and devices for energy and photonics. Current research focuses on the design, growth, and ageing control of the nanosystems processing. This research interest is on metal oxides and strongly correlated-electron materials.

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