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J Nanomed Nanotechnol 2017, 8:5 (Suppl)
DOI: 10.4172/2157-7439-C1-053

Investigation of electrospun urchin-like V_2O_3-CNF composite nanostructure for vanadium redox flow battery application

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In-house electrospun catalyst based on urchin-like vanadium (III) oxide-carbon nanofiber (V_2O_3-CNF) composite is synthesized from a solution containing vanadium (V) oxytriisopropoxide VO-(OiPr)3 as metal oxide precursor and polyvinylpyrrolidone (PVP) as carbon source for vanadium redox flow battery (VRFB) application. X-ray diffraction (XRD) as well as scanning electron microscopy (SEM) analysis shows a typical V_2O_3 rhombohedral structure and an urchin-like V_2O_3-CNF morphology, respectively. Cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) measurements show a high electrocatalytic activity in terms of peak to peak separation (ΔE=0.02 V) and lower charge transfer resistance (R_{ct}=0.12 ohm cm^2) with respect to a pristine CNF. The better performance could be due to the rhombohedral structure of V2O3 consisting in a 3D V-V framework in which a faster electron transfer along the V-V chains occurs. This mechanism gives a typical metallic behavior to the vanadium oxide and consequently a high electrical conductivity reducing the ohmic over potentials. Moreover, thanks to the catalytic effect and appropriate wettability due to the oxygen functional groups presence a reduction of the kinetic over potentials occur.

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