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Rapid single pot synthesis of hierarchical Bi_2WO_6 microspheres/RGO nanocomposite and its application in energy storage: A supercritical water approach

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ABSTRACT

The application of novel three-dimensional (3D) architectures in energy storage has fascinated researchers for a long time. The fast-paced technological advancements require reliable rapid synthesis techniques for developing multi-metal oxide (MMO) nanostructures. For the first time, we disclose the supercritical water method's use to synthesize a single-phase hierarchical three-dimensional (3-D) Bi_2WO_6 microsphere/Reduced Graphene Oxide (BWS/RGO) nanocomposite (SCW). Through various nano-characterization technologies, it is possible to confirm the sample characteristics and determine the nanocomposites' morphological, physical, and thermal properties. Additionally, the constructed coin cells' electrochemical behavior analyses shed light on their well-known higher initial cycle capacity of about 700 mAh g^{-1}, demonstrating BWS nanostructures' superior capacity for lithium-ion storage (Li-ion). In contrast, in supercapacitor studies, a half-cell configuration with a 6 M KOH electrolyte achieved its maximum specific capacity of 1158C g^{-1} at a current density of 3 A g^{-1}. Similarly, Trasatti's analysis shows that the false nature of the BWS/RGO material results in 83 % over capacitive behavior of 17 %. When it comes to effectively developing a material process technique for multi-metal oxides and associated RGO nanocomposites, the reported quick single-pot SCW approach has shown encouraging results.

1. Introduction

Novel materials in the field of energy storage are looked upon to realize the need for electrochemical storage systems [1,2]. Secondary batteries and supercapacitors have led the race in defining next-generation storage systems [3,4]. As of today, the available energy density of 210 Wh kg^{-1} from Li-ion battery chemistry is challenged by the exponential increase of electric vehicles [5]. Graphite materials are the most widely used for LIB anodes due to their advantages in safety, low cost, and stability [6,7]. But, a low capacity of 372 mAh g^{-1} theoretically limits its advantages in meeting the fast-growing needs of the battery industries [8]. Metal oxides such as V_2O_5, MoO_2, Fe_3O_4, TiO_2, NiO, and Co_3O_4 are investigated for negative electrodes in LIBs [9–14]. But, the aforementioned metal oxide chemistries suffer from challenges related to mechanical stability, conductivities, and larger expansions in volume during cycling hampers the life expectancy of these secondary batteries [15]. To counter the above-mentioned disadvantages of electrode materials, currently, the focus is on transition metal oxides (TMOs)

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