Large scale synthesis of binary composite nanowires in the Mn_2O_3-SnO_2 system with improved charge storage capabilities

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HIGHLIGHTS

- Nanowires of a composite, Mn_2O_3-SnO_2, are synthesized at 100 g scale.
- The composite nanowires showed beneficial properties of the constituents.
- They showed significantly high charge storability and cyclability than the constituents.
- The superior charge storage are attributed to lower characteristic resistances.

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ABSTRACT

Large scale production of electrochemical materials in non-conventional morphologies such as nanowires has been a challenging issue. Besides, functional materials for a given application do not often offer all properties required for ideal performance; therefore, a composite is the most sought remedy. In this paper, we report large scale production of a composite nanowire, viz. Mn_2O_3-SnO_2, and their constituent binary nanowires by a large scale electrospinning pilot plant consisting of 100 needles. Electrochemical characterization of thus produced composite nanowires showed nearly threefold increase in the discharge capacity compared to their single component counterparts: Mn_2O_3-SnO_2 ~53 mA h g^{-1} (specific capacitance, C_S ~384 F g^{-1}); Mn_2O_3 ~18 mA h g^{-1} (C_S ~164 F g^{-1}); and SnO_2 ~14 mA h g^{-1} (C_S ~128 F g^{-1}) at 1 A g^{-1} in 6 M KOH. The EIS studies showed that the characteristic resistances and time of the composite electrode are appreciably lower than their constituents. Owing to the scalability of the synthesis processes and promising capacitive properties achieved would lead the composite material as a competitive low-cost and high-performance supercapacitor electrode.