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Hierarchical Manganese and Nickel Selenide based Ultra-efficient Electrode Material for All-Solid-State Asymmetric Supercapacitors with Extended Energy Efficacy

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Abstract : Researchers are attempting to develop extremely efficient electrochemical energy storage technologies as a result of the phenomenal advancement of portable electronic devices. Because of their improved electrical conductivity and narrower band gap, transition metal selenide-based nanostructures have piqued the interest of many researchers in this field. Based on this concept, we present a simple anion exchange hydrothermal synthesis method for synthesizing manganese and nickel based selenide (Mn/NiSe2) nanostructure for use in all-solid-state asymmetric supercapacitors. According to the comprehensive physicochemical characterizations, the material has lowly crystalline properties, a distinct porous microstructure, and a significant bonding contact between the metal and the selenium. The electrochemical investigations of the Mn/NiSe2 electrode material revealed supercapacitive charge discharge properties, excellent electro-kinetic reversibility, and minimal charge transfer resistance (Rct). Furthermore, the all-solid-state asymmetric supercapacitor device assembled using Mn/NiSe2 as positive electrode, nitrogen doped reduced graphene oxide (N-rGO) as negative electrode, and PVA-KOH gel as electrolyte/separator exhibit good redox behaviour, excellent charge-discharge properties with negligible voltage (IR) drop, and lower impedance characteristics. The solid state asymmetric supercapacitor device (Mn/NiSe2||N-rGO) demonstrated the power density of ultra-capacitors and the energy density of rechargeable batteries. Conclusively, the Mn/NiSe2 has been proposed as a potential outstanding electrode material for the next generation of all-solid-state asymmetric supercapacitors.

Keywords : anion exchange, asymmetric supercapacitor, supercapacitive charge-discharge, voltage drop
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