Fe_3O_4/SnO_2/rGO Nanocomposite for Supercapacitors and Visible-Light Induced Photocatalytic Studies: A Synergistic Performance

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To optimize device performance, both surface area and pore shape are key design criteria in nanomaterial fabrication. The present work produced a nanocomposite Fe_3O_4/SnO_2/rGO with improved pore size and a substantially larger surface area, compared to the single-metal-oxide composites Fe_3O_4/rGO and SnO_2/rGO. Higer surface area and pore structure of the ternary nanocomposites led to better results for the supercapacitor and photocatalyst. The ternary nanocomposites demonstrated a capacitance of 967.5 F g^{-1} at a 1 A g^{-1} current density, while sustaining a capacitance of 98% after 5000 cycles. Additional tests were conducted to verify the photocatalytic activity with visible light irradiation (λ > 500 nm) and demonstrated significant methylene blue dye degradation (as much as 92 %), with a very short time period. The synergistic interactions of Fe_3O_4, SnO_2, and rGO hindered nanoparticle growth and aggregation, enhancing electrical conductivity and surface area in supercapacitor and photocatalytic applications. This study sheds light on the possiblilty of creating novel active materials with large surface areas using hydrothermal methods.