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Nanocomposite of copper spinel: A novel hybrid material for energy storage application

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In the context of global energy crisis and severe environmental concerns, the thirst to explore and develop novel alternative green energy sources has become the most important priority. In this scenario, novel energy storage materials have attracted a significant interest due to their superior properties such as high energy density, power density, long cycling life, fast charge/discharge process and environmental friendliness. Among spinel oxides, $CuCr_2O_4$ is unique, economical and nontoxic in nature. So far, $CuCr_2O_4$ has been used as an efficient catalyst for various chemical reactions such as hydrogenation, dehydrogenation, oxidation, alkylation, etc. $CuCr_2O_4$ has also been exploited as a burn rate modifier in solid propellant processing for rockets and missiles. Furthermore, several other uses of $CuCr_2O_4$ include sensors, semiconductors, heat-resistant pigments etc. Nevertheless, there are very few reports on the feasibility of employing $CuCr_2O_4$ as electroactive material for energy storage. In this study, we report a novel copper chromite-polyaniline ($CuCr_2O_4$ -PANI) nanocomposite electrode material for fabrication of high-performance energy storage. First $CuCr_2O_4$ is synthesized *via* sol-gel driven epoxide method followed by its nanocomposite with PANI through in situ chemical oxidative polymerization method. The micro structure and morphology of $CuCr_2O_4$ -PANI are characterized by various techniques. The as synthesized nanocomposite with optimized ratio exhibits a specific capacity of 479.2 C g-1 at 2 mV s-1 and high cycling stability with 93.9% capacity retention after 1000 charge-discharge cycles. Furthermore, it shows energy and power densities of 26.6 Wh kg-1 and 3600 W kg-1, respectively. The change in electrochemical properties of the nanocomposite with increasing $CuCr_2O_4$ loading is explained in detail.

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