Synthesis and characterization of nanocrystalline calcium hexaboride powders as a supercapacitor anode component

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Energy demand increases with the growing world population and the popularisation of portable electronics and electric vehicles that stimulates the development of energy storage devices such as batteries and supercapacitors from high power and energy density, which significantly relies on the research and development of advanced and unique materials. Supercapacitors (SCs) are energy storage devices commonly used in various applications that require an instantaneous power supply and fast response times. Therefore, obtaining high performance requires continuous development and modification of electrode materials. An ideal electrode for SC should exhibit high specific capacity and specific capacitance. The materials for efficient SCs should have good electronic and ionic conductivity and a high surface area with a porous structure. In recent years, a significant amount of research has been focused on improving supercapacitors' electrochemical performance by developing new anode materials. This study uses a low-cost solution-based process to synthesize Calcium Hexaboride powders as a supercapacitor anode material.

Calcium Hexaboride (CaB_6) is an alkaline earth metal boride with a high melting point (2235°C), high chemical stability, high hardness (27GPa), low density (2.45 g/cm^3) and high conductivity (bandwidth:0.8± 0.1 eV) [1]. Due to these properties, it has a wide range of applications such as anti-oxidant in the refractory industry, wear resistance structural ceramic and precursor in the production of boron nitride [2]. In this study, the synthesis, characterization and potential usage of CaB_6 powders as an anode component in energy storage applications were investigated. The properties (structural, physical and microstructure) of the synthesized powders were determined by XRD, FE-SEM and FTIR. The structural defect analysis was performed using the EPR technique. Electrochemical (CV, EIS, GCPL) measurements of the supercapacitor application of the powder were performed. 0.163 mA and 0.229 mA current ranges were obtained in the symmetrical device and in the asymmetrical device prepared with a graphite electrode, respectively. These results revealed that CaB_6 has potential as a new anode material for supercapacitor applications.

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