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AVIS DE SOUTENANCE

«MEHDI KARBAK»

Présentera ses travaux de recherche en vue de l'obtention du Doctorat en Sciences et Techniques

Intitulé de la thèse :

« Unleashing the Potential of Manganese Oxide materials in Advanced Aqueous Energy Storage devices: Asymmetric Supercapacitors and Zinc-Ion Batteries »

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ABSTRACT

As global energy consumption continues to rise, it is increasingly crucial to transition to renewable energy sources to mitigate the negative impacts of fossil fuels on the environment. However, the intermittency of renewable energy sources necessitates the implementation of efficient energy storage systems. The development and implementation of energy storage technology must also consider safety and sustainability concerns, as current storage systems utilizing chemical processes can pose risks to both human health and the environment. Advanced energy storage systems incorporating aqueous electrolytes-based cells, such as aqueous asymmetric supercapacitors and aqueous zinc-ion batteries, may offer more sustainable and safer alternatives to different energy storage applications. The advancement and widespread adoption of these technologies will play a critical role in the realization of a sustainable energy future. Consequently, scientists find that developing novel electrode materials for such energy storage systems will certainly enclose their commercialization to a global scale.

This dissertation delves into the fabrication of various manganese oxide materials through a solvent-assisted reduction method, from the production of amorphous manganese oxides with controlled particle size to crystalline manganese oxides showcasing diverse polymorphic and valence characteristics. These materials are structurally, texturally and electrochemically characterized before being implemented into their respective aqueous energy storage system. For instance, amorphous manganese oxide was used in a self-assembly synthesis method to produce a manganese oxide-graphene oxide composite (MnO2-GO). The synthesized material exhibited great electrochemical properties when used as a positive electrode for aqueous asymmetric supercapacitors, reaching high specific capacitance 38 F.g-1 at 1 A.g-1 and excellent cycling stability after 36 000 cycles.

Amorphous manganese oxide was implemented further next to its crystalline counterparts as cathode materials for aqueous zinc-ion batteries. As a result, each material exhibited different electrochemical performance and cycling mechanisms. Finally, the synthesized materials after a simple oxygen deficiency treatment can reach a high specific capacity of 600 mAh.g-1 which to our knowledge was never reported before.

Keywords: Manganese oxide, aqueous energy storage systems, asymmetric supercapacitors, zinc-ion battery