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Revolutionizing Aqueous Aluminum-Ion Batteries: Manganese Carbonate as a Cathode Material.

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The increasing demand for clean energy has led researchers to find alternatives for efficient energy storage solutions. While lithium-ion batteries (LIBs) are a promising technology, they face problems in terms of safety, availability, environmental impact and cost. Hence, aqueous metal ion batteries such as Na-ion, Zn-ion, Al-ion batteries are being explored. Aqueous Aluminum ion batteries (AAIBs) have gained interest in the recent years due to their multi electron redox reactions, abundance, safety and low cost. However, in the aqueous AIB systems, a major problem is the availability of suitable cathode materials, high overpotential and structural degradation of the electrode material. In order to overcome such challenges, we need to come up with electrode materials with high tunability, high theoretical capacity and environment friendliness [1]. Herein, a focus on MnCO_3 as a potential cathode in aqueous aluminum ion battery is studied. Manganese, particularly, manganese oxides, are being explored as anode materials in lithium-ion batteries (LIBs) [2]. However, the preparation of manganese oxides requires high-temperature calcination treatment. Hence, MnCO_3 is considered as an alternative to manganese oxides as its production does not require high-temperature processing, which reduces the cost and safety risks. MnCO_3 has been investigated as anode material for LIBs [3]. However, there are issues such as low electron conductivity, which hinders its performance. These issues are being addressed by creating a composite material using highly conductive nanosheets [4]. Hence, in this work I have tried to investigate the electrochemical properties of MnCO_3 in AAIB system due to its high natural abundance, low toxicity and low cost. The electrochemical activities of MnCO_3 are investigated using cyclic voltammetry (CV) and galvanostatic charge-discharge (GCD) in a three-electrode glass cell set up with Pt and Ag/AgCl as counter and reference electrodes respectively. The voltage range is taken to be 0 V to 1.2 V. To investigate the Al^{+3} ion storage behavior in MnCO_3 ; 1 M AlCl_3 , 0.5 M $\text{Al}_2(\text{SO}_4)_3$, and 1 M $\text{Al}(\text{ClO}_4)_3$ electrolytes were employed. Further, the work is extended by making a composite of MnCO_3 with graphene in order to enhance its electrochemical performance and provide a new framework towards stable energy storage systems.

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