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INVESTIAGTION OF NANOSTRUCTURED Bi2Se3 THIN FILMS AS ANODES FOR AQUEOUS RECHARGEABLE LITHIUM-ION BATTERIES

In the last decade, lithium-ion batteries (LIBs) have dominated the world as the most efficient electrical energy storage device. In comparison with lead-acid or carbon-zinc batteries LIBs have a supreme energy density (>200 Wh kg-1), cycle life (up to 3000 cycles), and energy efficiency (>95 %). Despite their huge advantages, however, the use of non-aqueous electrolytes (e.g., LiBF4, LiPF6) is still considered to be a serious drawback of LIBs, as they are flammable, and can be unfriendly to the ambient environment. To solve these shortcomings, the alternative way is to use aqueous electrolytes (e.g., LiNO3, Li2SO4). The first concept of aqueous rechargeable lithium-ion batteries (ARLIBs) was demonstrated in 1994 by Dahn and his research group by showing a possible perspective of the application of lithium aqueous electrolytes. Bi2Se3 is a unique material with a layered structure that has already shown great promise as an anode in LIBs.

This research demonstrates the investigation of the electrochemical properties of Bi2Se3 thin films with formed solid electrolyte interphase (SEI) and Bi2O3 layer. As an electrolyte 5 M LiNO3 was used which is more electrochemically stable than Li2SO4 and LiCl. Bi2Se3 thin films were synthesized using physical vapour deposition. In this work was applied different electrochemical measurements techniques (cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS), and charge/discharge) to investigate the electrochemical properties.

The analysis of Bi2Se3 thin films in the lithium aqueous electrolyte was investigated for the first time to show the perspective application as anode for ARLIBs and the difference of electrochemical properties between formed SEI and Bi2O3 layer. Results of this work demonstrated that Bi2Se3 thin films with formed SEI layer (Li2O and Li2CO3) on the electrode surface ensure high diffusivity of Li+, high electrochemical stability, and high capacity up to 100 cycles.

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