World Academy of Science, Engineering and Technology
International Journal of Energy and Power Engineering
Vol:17, No:12, 2023

An Anode Based on Modified Silicon Nanostructured for Lithium – Ion Battery Application

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Abstract : Lithium-ion batteries (LIBs) are widely used in various electronic devices due to their high energy density. However, the performance of the anode material in LIBs is crucial for enhancing the battery's overall efficiency. This research focuses on developing a new anode material by modifying silicon nanostructures, specifically porous silicon nanowires (PSiNWs) and porous silicon nanoparticles (NPSiP), with silver nanoparticles (Ag) to improve the performance of LIBs. The aim of this research is to investigate the potential application of PSiNWs/Ag and NPSiP/Ag as anodes in LIBs and evaluate their performance in terms of specific capacity and Coulombic efficiency. The research methodology involves the preparation of PSiNWs and NPSiP using metal-assisted chemical etching and electrochemical etching techniques, respectively. The Ag nanoparticles are introduced onto the nanostructures through electrodissolution of the porous film and ultrasonic treatment. Galvanostatic charge/discharge measurements are conducted between 1 and 0.01 V to evaluate the specific capacity and Coulombic efficiency of both PSiNWs/Ag and NPSiP/Ag electrodes. The specific capacity of the PSiNWs/Ag electrode is approximately 1800 mA h g-1, with a Coulombic efficiency of 98.8% at the first charge/discharge cycle. On the other hand, the NPSiP/Ag electrode exhibits a specific capacity of 2600 mAh g-1. Both electrodes show a slight increase in capacity retention after 80 cycles, attributed to the high porosity and surface area of the nanostructures and the stabilization of the solid electrolyte interphase (SEI). This research highlights the potential of using modified silicon nanostructures as anodes for LIBs, which can pave the way for the development of more efficient lithium-ion batteries.

Keywords : porous silicon nanowires, silicon nanoparticles, lithium-ion batteries, galvanostatic charge/discharge
Conference Title : ICBEST 2023 : International Conference on Batteries and Energy Storage Technology
Conference Location : Rome, Italy
Conference Dates : December 11-12, 2023