Optimizing the Capacity of Sodium Ion Batteries

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Energy transition and storage have become one of the main problems intervening in battery development. Recently, sodium-ion batteries (NIBs) have garnered research interest because abundant resources make them a cost-effective alternative to commonly used lithium-ion batteries (LIBs). In this research, Germanium (Ge) is used for the first time (to the researcher's knowledge) as the anode material for NIBs due to its high theoretical capacity. Thin film anodes were prepared sputtering Ge directly on copper, which was used as a current collector. They were characterized by using scanning electron microscopy and Raman spectroscopy. A constant thickness of 500 nm was used for the optimization of cut-off voltage limit. Furthermore, NIBs were fabricated by using Ge as the anode and sodium metal as the cathode. Then, electrochemical characterization was implemented. The lower potential window was set at 0.01 V and the upper cutoff voltage was varied from 2.00 – 3.00 V. The galvanostatic charge/discharge testing and cyclic voltammetry were applied. The capacity retention after the 10th cycle was only 30% when the upper cutoff voltage was set at 3.00V. When the limit was set at 2.50V, the battery retained 60% of its initial capacity. At 2.00V, the capacity retention was 66%. It was found that cyclic performance of Ge anode depends heavily on cut–off voltage limit. The results of this study may lead to beneficial applications with batteries, such as electric and hybrid vehicles and power backups, which require both high energy and high power densities.