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Activities of the Core

Dec. 1, 2020	The 90th Hiroshima University Biomass Evening Seminar (co-organized).
Dec. 7-8, 2020	The 4th International Symposium on Fuels and Energy (ISFE2020).
Dec. 23, 2020	The 52nd HU-ACE Steering Committee Meeting.

The ISFE2020 was held successfully online.

The 4th International Symposium on Fuels and Energy (ISFE2020) hosted by Advanced Core for Energetics, Hiroshima University (HU-ACE) was initially planned to take place in July at Higashi Hiroshima Arts & Culture Hall 'Kurara', however, it was postponed until December due to the outbreak of COVID-19. We were looking for an opportunity for a face-to-face meeting, however that was found to be difficult, so we decided to hold the symposium online, rather than postpone it further. Unfortunately, the number of attendees, especially the number of invited lecturers, decreased from last year. But, it was a fruitful meeting of lectures, presentations and discussions on the broad topic areas of fuels and energy thanks to the cooperation of all the attendees. The organizers would like to deeply thank all the attendees and collaborators, and hope for a successful face-to-face meeting in the near future.

Figure Web site of ISFE 2020

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Research Topics

Bismuth Chalcogenide based Anodes for All Solid-State Lithium-Ion Batteries

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Research fields: Li ion Batteries, Energy storage and Material Science
Keywords: Bi-chalcogenides, Li Ion batteries

Abstract

Background

The continuous depletion of fossil fuels and their hazardous byproducts are leading us in the search for clean and sustainable sources of energy. Lithium-Ion batteries (LIBs) provide many advantageous features on the commercial level *i.e.*, high specific energy, long cycle life, low self-discharge, and their environmental friendliness. Bismuth chalcogenide materials possess higher theoretical capacity than the commercial graphite-based anodes. Nanostructuring of these bismuth chalcogenide materials provides a better cycle life and electrochemical performance[1].

Methods

Bulk and the nanostructures Bi_2X_3 (X= Sulfur, Selenium and Tellurium) are implemented as anode materials. Different morphologies of Bi_2S_3, Bi_2Se_3, and Bi_2Te_3 were synthesized by the hydrothermal approach. The electrochemical performance of the synthesized nanostructures were further compared with the bulk materials. The electrochemical mechanism was established, and their cyclic stability was also confirmed.

Results

In terms of theoretical capacity, Bi_2S_3 possesses the highest capacity, almost twice than the graphite-based anodes. The reaction mechanism is the same for all three composites due to their layered structure. In the case of nanostructures, they show better performance than compared to bulk. In the case of Bi_2Se_3, the first discharge capacity of nano Bi_2Se_3 was found to be 594 $mAhg^{-1}$ while after the 30th cycle, this capacity reduced to 395 $mAhg^{-1}$. In the case of bulk, this capacity found 330 $mAhg^{-1}$, which was less compared to the nanostructures. This was facilitated by the higher surface area of nanostructures and excellent charge transfer kinetics due to their shorter diffusion path. The nano-Bi_2Se_3 composites showed only 15% capacity decay compared to the initial capacity and 99% coulombic efficiency in the potential window 0.2-1.5V [2]. These similar results were found in case Bi_2S_3 and Bi_2Te_3 [3]. Solid-state electrolyte provides the cushioning effect for the anode materials, which is better than the liquid electrolytes. Solid-state batteries are a good alternative for conventional batteries and can be adopted for next-generation of Li-ion batteries.

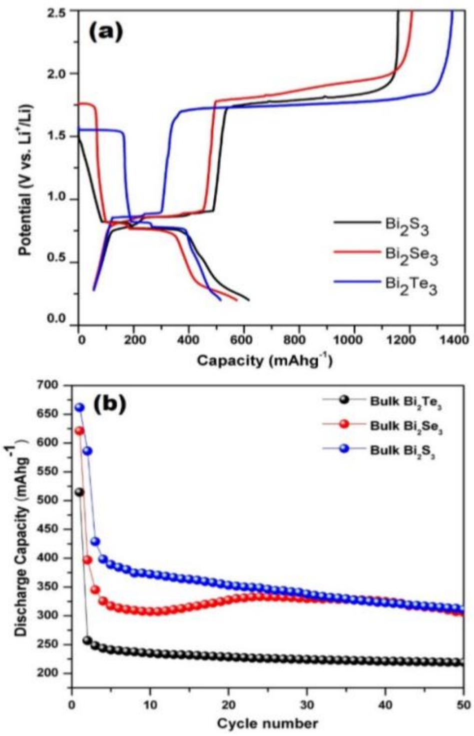

Fig. 1. Electrochemical Charge-Discharging of Bi_2X_3, Cyclic stability of Bi_2X_3 bulk materials.

References

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