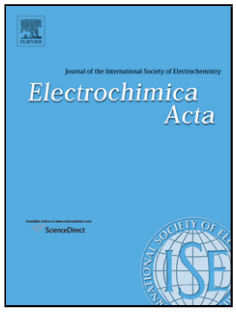

Title: Experimental Study on Sodiation of Amorphous Silicon for Use as Sodium-Ion Battery Anode

Author: Chek-Hai Lim Tzu-Yang Huang Pei-Sian Shao Jen-Hao Chien Yu-Ting Weng Hsin-Fu Huang Nae-Lih Wu

PII: S0013-4686(16)31348-2
DOI: http://dx.doi.org/doi:10.1016/j.electacta.2016.06.031
Reference: EA 27470

To appear in: *Electrochimica Acta*

Received date: 5-4-2016
Revised date: 21-5-2016
Accepted date: 5-6-2016

Please cite this article as: Chek-Hai Lim, Tzu-Yang Huang, Pei-Sian Shao, Jen-Hao Chien, Yu-Ting Weng, Hsin-Fu Huang, Nae-Lih Wu, Experimental Study on Sodiation of Amorphous Silicon for Use as Sodium-Ion Battery Anode, Electrochimica Acta http://dx.doi.org/10.1016/j.electacta.2016.06.031

Experimental Study on Sodiation of Amorphous Silicon for Use as Sodium-Ion Battery Anode

By: Chek-Hai Lim, Tzu-Yang Huang, Pei-Sian Shao, Jen-Hao Chien,

Yu-Ting Weng, Hsin-Fu Huang, and Nae-Lih Wu

Department of Chemical Engineering
National Taiwan University
Taipei 106, Taiwan

Abstract

Amorphous Si (*a*-Si) powders have been synthesized using various synthetic methods, and their electrochemical sodiation behaviours have been studied in detail. These methods include (1) a chemical delithiation method where Si is first lithiated and then delithiated either in an aqueous or organic solution, (2) a mechanical method where crystalline Si is subjected to high-energy ball milling, and (3) a mechanical fusion method where a Si-Sn composite with a Si-Sn atomic ratio of 0.94:0.06 is synthesized through high-energy ball milling. Commercial silicon monoxide (SiO) has also been examined for comparison. It is shown that facile oxidation of *a*-Si encountered in the methods (1) and (2) has led to low sodiation capacity and huge first-cycle irreversible capacity, similar to those of SiO. By contrast, the mechanically fused Si-Sn composite, which contains a Sn shell that prevents the oxidation of the partially amorphized Si core, exhibits a maximum sodiation capacity of 161 mAh g^{-1} based on active material. This is translated to an estimated sodiation capacity of no more than 230 mAh g^{-1} for the *a*-Si component in the composite. The presence of the Sn shell considerably reduces the first-cycle irreversible capacity and charge-transfer resistance, resulting in improved rate