Conductive and Porous SnCu-Coated Carbon Cloth Network for Binder-free Li-Ion Storage Anodes

Venroy Watson¹, Wete Telama¹, Yaw Yeboah¹, Jim Zheng², Egwu Eric Kalu^{1,*}

¹ Department of Chemical and Biomedical Engineering, FAMU-FSU College of Engineering, 2525 Pottsdamer St., Tallahassee, FL 32310

² Department of Electrical and Computer Engineering, FAMU-FSU College of Engineering, 2525 Pottsdamer St., Tallahassee, FL 32310

*E-mail: ekalu@eng.famu.fsu.edu

doi: 10.20964/2019.02.01

Received: 25 July 2018 / Accepted: 16 November 2018 / Published: 5 January 2019

Large volume change occurs during lithiation/delithiation of Sn anodes and result in pulverization, poor cycling, capacity loss and anode degradation that impedes the general use of Li-ion batteries. This study proposes a time-controlled synthesis approach for 1-D SnCu nanoparticles on three-dimensional anode by electrolessly adhering Cu to C cloth and subsequently Sn on the Cu. After annealing at 200 °C, electrically conductive, porous, flexible and mechanically stable CuSn alloy anode results. The CuSn anodes exhibited high conductivity due to copper deposit, accommodated volume changes and stress due to both 1-D-deposit and porosity and have high electrochemical activity due to large surface area. After 100 cycles, the sample deposited for the shortest time (1.5 min) interval and close to 1-D SnCu deposit has a specific discharge capacity of ~605 mAh g⁻¹ which contrasts to the ~400 mAh g⁻¹ obtained for the sample deposited for 6 min. The specific electrode surface area of the 1.5 min sample was 169 m² g⁻¹ in contrast to 6.4 m² g⁻¹ obtained for the 6 min sample. A rate capability of 520 mAh g⁻¹ at a current density of 583 mA g⁻¹ was achieved for the thinnest deposit. The porous Sn anode materials demonstrated low resistance during electrochemical impedance analysis and showed high reversible redox reactions during cyclic voltammetry tests. The achievement of high capacity anode (comprising of Sn-SnO₂-Cu₆Sn₅) with good reversible capacity retention through electroless coating method indicates that electroless deposition on flexible free-standing and porous substrate is an effective Sn anode fabrication technique.

Keywords: Sn anode; Electroless deposition; Cu-Sn alloy; cyclability; binder-free

[FULL TEXT](#)

© 2019 The Authors. Published by ESG (www.electrochemsci.org). This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).