Preparation of Encapsulated Sn-Cu@graphite Composite Anode Materials for Lithium-Ion Batteries

Venroy Watson¹, Yaw Yeboah¹, Mark Weatherspoon², 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: 10.20964/2018.08.39

Received: 20 March 2018 / *Accepted:* 17 May 2018 / *Published:* 5 July 2018

Electroless encapsulation of graphite particles with copper-tin alloy (Sn-Cu@graphite) is demonstrated as a feasible anode preparation method that is cost effective and provides both high cyclability and reversible capacity. Heat treatment of the electroless composites at 200 °C yielded Sn-Cu@graphite anode composites with a 20 wt.% Sn loading, specific surface area of 22.5 m²/g and a 1st discharge capacity of 1074 mAh/g at 0.2C rate. In contrast, the graphite substrate particles used for the encapsulation has a surface area of 2.34 m²/g and a 1st cycle discharge capacity of 327 mAh/g at 0.2 C rate. At the 300th cycle, these capacities decreased to ~400 mAh/g and 208 mAh/g for the Sn-Cu@graphite and graphite substrate, respectively. Above 300 cycles, the electroless encapsulated Sn-Cu@graphite anode maintained a capacity higher than that determined experimentally and theoretically for graphite. The electrochemical impedance and cyclic voltammetric results demonstrate that the electroless encapsulated Sn-Cu@graphite anode has very low resistance and high reversible redox reactions. The higher capacity and long term cycling (> 300 cycles) achieved with the electroless composite anodes are attributed to the buffering effect of the electroless Cu in the Sn-Cu alloy encapsulating graphite particles, Sn-Cu@graphite's higher surface area (22.5 m²/g), and curvature of the graphite particles. The electroless encapsulated Sn-Cu graphite composite anode materials with extended cycling have potential application for the anode of Li-ion battery.

Keywords: Copper tin alloy, Tin oxide, Anode, Lithium ion battery electrode

[FULL TEXT](#)

© 2018 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/>).